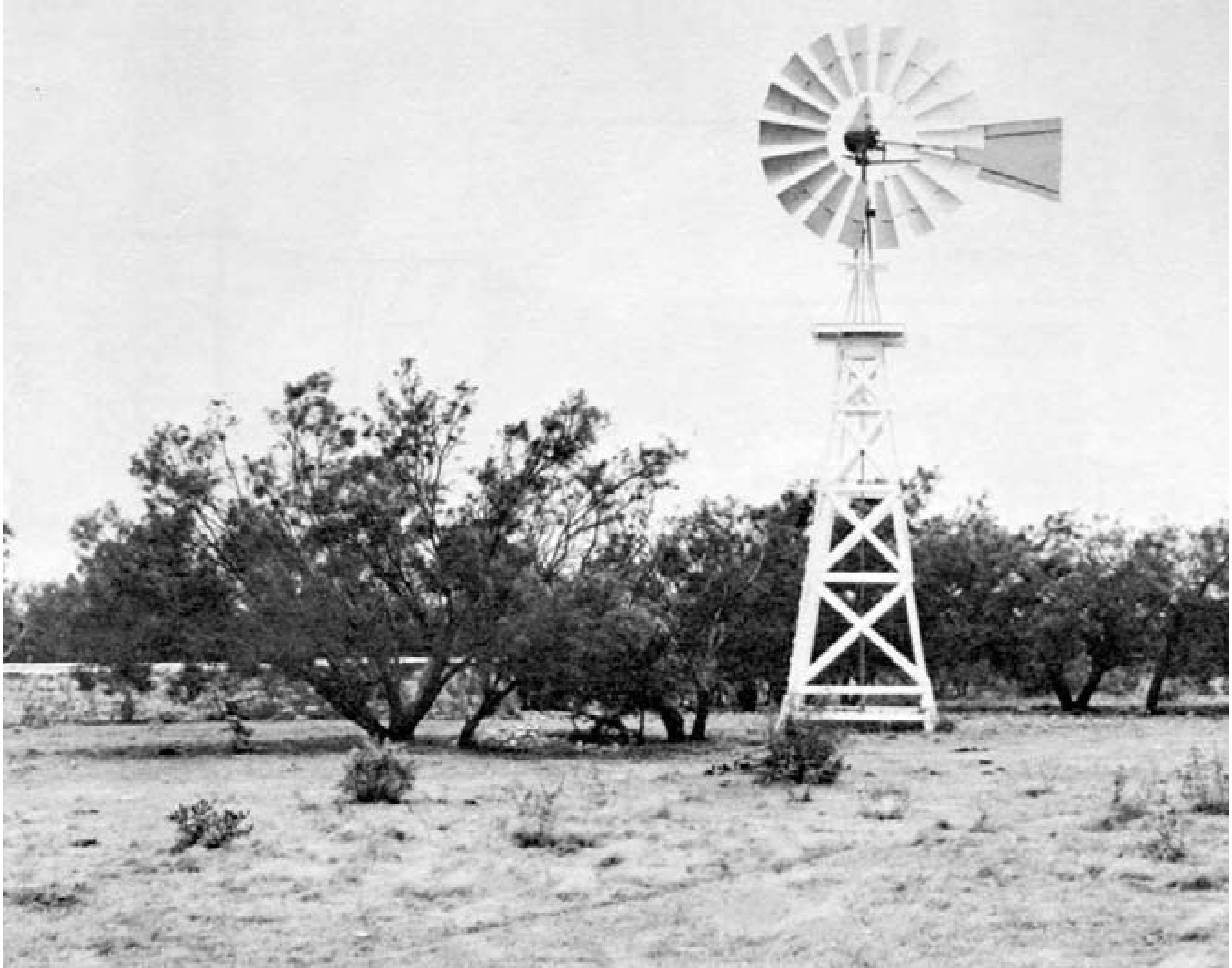
ELECTRONIC VERSION

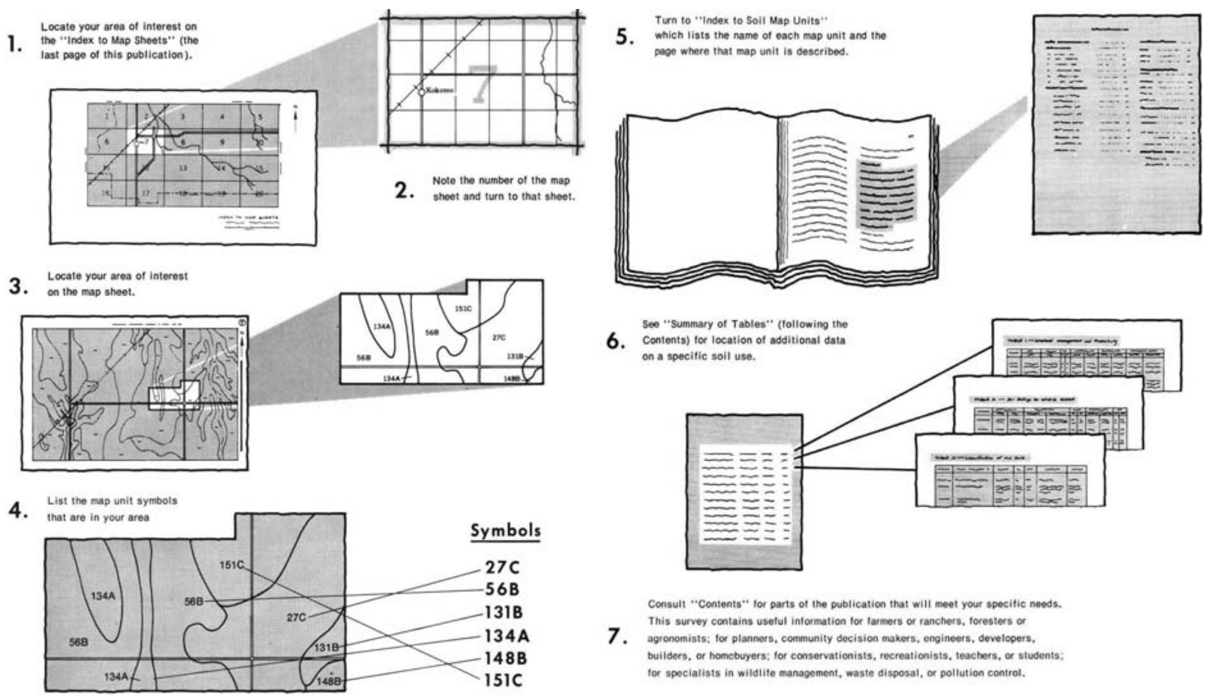
This soil survey is an electronic version of the original printed copy, dated January 1980. Additional and updated information may be available from the Web Soil Survey. In Web Soil Survey, identify an Area of Interest (AOI) and navigate through the AOI Properties panel to learn what soil data is available.

Soil Survey of Schleicher County Texas



United States Department of Agriculture, Soil Conservation Service
in cooperation with Texas Agricultural Experiment Station

HOW TO USE THIS SOIL SURVEY



This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was performed in the period 1971-1975. Soil names and descriptions were approved in 1977. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1976. This survey was made cooperatively by the Soil Conservation Service and the Texas Agricultural Experiment Station. It is part of the technical assistance furnished to the Eldorado Divide Soil and Water Conservation District.

Cover: Underground water provides the major supply for livestock and homes.

Contents

Issued January 1980

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Summary of tables

*The tables listed below have been reformatted to accommodate file size and accessibility. The original tables along with the manuscript and maps are available on CD and paper copy. A copy can be obtained by contacting the Field office.

Note: The Soil Data Mart may provide more up-to-date tables for this survey area.

Foreword

This soil survey contains information that can be used in land-planning programs in Schleicher County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

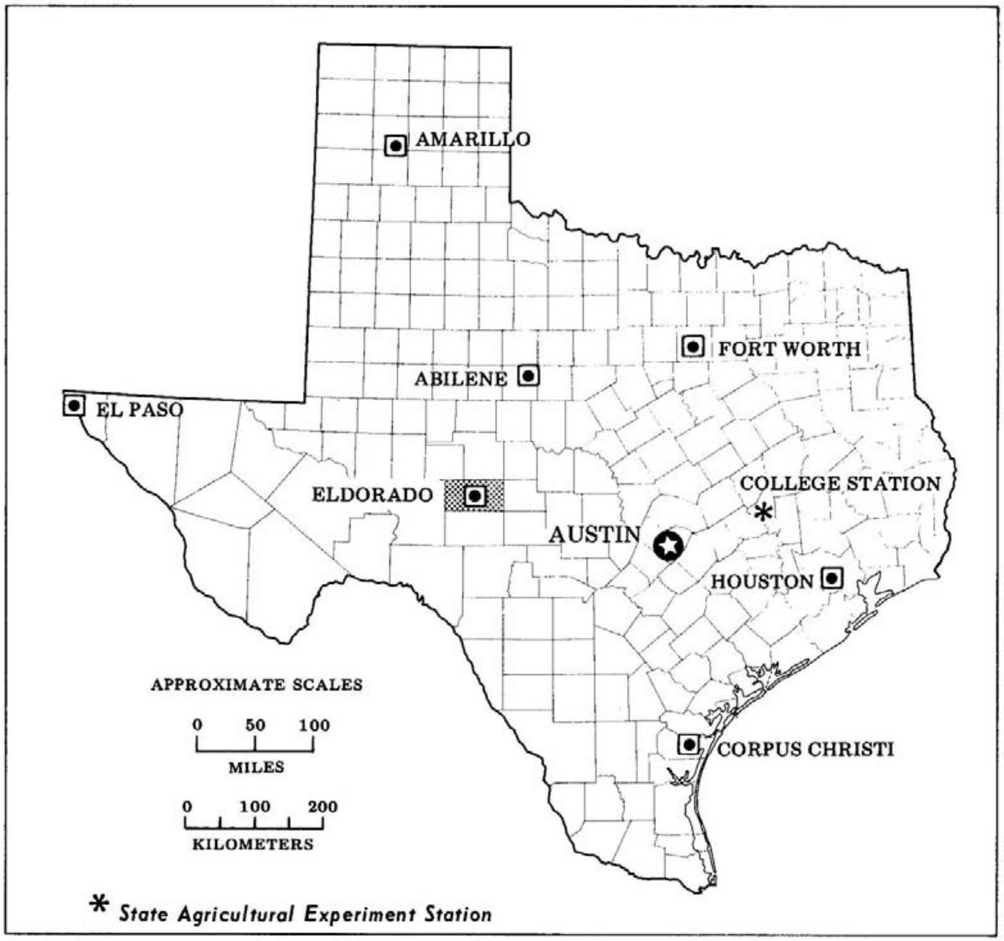
This soil survey is designed for many different users. Farmers, ranchers, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

George C. Marks

George C. Marks
State Conservationist
Soil Conservation Service



Location of Schleicher County in Texas.

Soil Survey of Schleicher County, Texas

by C. C. Wiedenfeld, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service
in cooperation with Texas Agricultural Experiment Station

General nature of the survey area

SCHLEICHER COUNTY, in the southwestern part of Texas, has an area of 851,840 acres, or 1,331 square miles. Eldorado, the county seat, is the only town in the county. The population of Eldorado was 1,446 in 1970, and the population of the county was 2,227.

Permanent settlers began to move into the area about the middle of the 19th century. In 1887 Schleicher County was created from Bexar County. It was named for Gustavus Schleicher, a member of the Texas Legislature and later a member of Congress. The county was organized in 1901 when a great land rush began near Eldorado.

Climate

Variations in the time and amount of rainfall and in temperature cause considerable variation in plant growth. The soils are usually moist. "Usually moist" means that in most years the soil has sufficient moisture for plants for more than half the year. Just west of the county the soils are usually dry.

The average annual rainfall is about 18 inches. Most rain falls during thunderstorms in May through September when the prevailing southerly or southeasterly circulation carries Gulf moisture inland. Thunderstorm rainfall varies greatly from year to year and within short distances. During the colder months frequent surges of cold, dry polar air close off the Gulf source of moisture so that snow or rainfall is quite low. During the cold season, rainfall averages about 1 inch per month. The highest rainfall, about 3 inches, occurs in May. A second rainy period occurs in fall; about 2 inches falls in September.

The humidity is low, and wind movement and temperatures are high; therefore, evaporation is high. About 70 inches of water evaporates from open water surfaces annually.

The average annual temperature is about 65 degrees F. The first killing frost usually occurs around the middle of November, and the last killing frost late in March. The length of the growing season is about 230 days.

Relief and drainage

Schleicher County is entirely within the Edwards Plateau Land Resource Area. In nearly all places the Edwards Plateau is strongly dissected by deep, narrow valleys, but the central part of this county is a nearly level undissected plateau or "divide" 4 to 12 miles wide and about 2,400 feet in elevation.

Runoff on the divide is to closed intermittent lakes or to sinkholes and caverns (fig. 1). Runoff to the south drains to the Devils River, runoff to the north to the South Concho River, and runoff to the east to the San Saba River. These rivers are intermittent streams. The San Saba, however, becomes a perennial stream 1 mile before it flows eastward out of the county.

Figure 1.—Karst topography. Rubble-filled caverns extending into the underground limestone are important water recharge areas. They occur in broad depressions.

Natural resources

Natural resources important to the economy are the soils, the oil and gas, the wildlife, and the underground water.

All the soils in the county are derived from Lower Cretaceous limestone and marl or from alluvium from limestone and marl. About one-fifth the soils are more than 30 inches deep. More than half are less than 1 foot deep. All are dark and moderately alkaline. About 45 percent are nearly level. The rest range from gently sloping to steep.

The income from oil and gas is more than twice the income from agriculture. Recently, drilling operations at the southwest corner of the county have been expanding.

Hunting is important to the economy. Large numbers of hunters lease hunting rights from ranchers and buy supplies from local merchants. White-tailed deer and wild turkey are the main game. Peccary, mourning dove, bob-white quail, and scaled quail are also abundant.

Underground water for home and livestock use is adequate throughout the county. Most wells are between 200 and 400 feet deep, and a few are 500 feet. They yield from a few gallons to 1,200 gallons per minute. The most productive wells are closest to the springs on the South Concho River, the Devils River, the San Saba River, and Dove Creek. These springs and flowing streams are likely to dry up if irrigation increases.

Agriculture

About 807,000 acres, or 94 percent of the county, is rangeland. About 90 percent of the annual agricultural income is from the sale of livestock. Beef cattle number about 30,000, dairy cattle about 160, sheep about 125,000, and Angora and Spanish goats about 50,000.

About 10 percent of the annual agricultural income is from crops. About 38,000 acres is cropland. In 1974 about 2,600 acres was irrigated. Most of the cropland is used for supplemental feed crops for livestock. Supplemental feed crops include forage sorghum and alfalfa for grazing, hay, and silage and wheat, oats, and barley for winter grazing and hay. In years when rainfall is favorable, the small grain is allowed to mature and produce grain. The main harvested crops are cotton and grain sorghum. Vegetables are grown on a few hundred acres of irrigated land.

How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nation-wide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The soils in the survey area vary widely in their potential for major land uses. Table 1 shows the extent of the map units shown on the general soil map. It lists the potential of each, in relation to that of the other map units, for major land uses and shows soil properties that limit use. Soil potential ratings are based on the practices commonly used in the survey area to overcome soil limitations. These ratings reflect the ease of overcoming the limitations. They also reflect the problems that will persist even if such practices are used. The table lists only the principal soils and the principal adverse factors affecting use. Soils of minor extent within the unit are not rated. Furthermore, the rating may apply to one component of the unit and not to the others.

Each map unit is rated for *cultivated crops and specialty crops, rangeland, urban uses,* and *recreation areas.* Cultivated crops are those grown extensively in the survey area. These crops include cotton, grain sorghum, wheat, oats, and forage crops for hay and grazing. Specialty crops are the vegetables and fruits that generally require intensive management. Rangeland refers to areas of native or introduced plants. Urban uses include residential, commercial, and industrial developments. Recreation areas are campsites, picnic areas, ballfields, and other areas that are subject to heavy foot traffic.

Presently about 94 percent of the county is rangeland, and about 4 percent is cropland. About 27 percent of the county could be used as cropland if the need arose. The percentage of arable soil is greater, but some spots are isolated, and some are narrow strips that are not likely to be cultivated.

The acreage of irrigated land has decreased in recent years. In 1964 this acreage was 4,100 and in 1974 it was 2,600. The water supply was about the same throughout the period. In 1974 about 100 acres of pecans and 300 acres of vegetables were irrigated. The acreage of cropland, rangeland, and urban land has changed very little in recent years.

Generally, soil slope, soil depth, and low rainfall are the most important factors that influence land use in Schleicher County.

The general information in this section and the more detailed information in the following sections can be used as a guide in planning orderly growth and development. The information is especially helpful in determining which land to allocate to each use.

Descriptions of map units

1. Tarrant-Ector

Very shallow cobbly clays and very gravelly clay loams that are nearly level to hilly

The characteristic landscape of this unit is sloping uplands supporting many live oak and juniper trees (fig. 2). The slope range is 0 to 30 percent.

This unit makes up 60 percent of the county. It is 65 percent Tarrant soils, 10 percent Ector soils, and 25 percent other soils.

Tarrant soils are dark grayish brown, moderately alkaline cobbly clay that is about 50 percent limestone fragments. They are about 10 inches thick over fractured limestone bedrock. Ector soils are dark grayish brown, moderately alkaline very gravelly clay loam about 8 inches thick over limestone that is coated with indurated caliche. Most cracks in the limestone are sealed.

Figure 2.—Typical landscape in the Tarrant-Ector unit

Other soils included are the Angela, Cho, Kavett, Mereta, and Valera soils. Angelo soils are deep and loamy and occur on valley floors, Cho soils are gravelly and loamy and are very shallow over caliche. Kavett soils are clayey. They are shallow over hard limestone. Mereta soils are loamy and are shallow over caliche. Valera soils are clayey and are moderately deep over hard limestone.

This unit is mostly rangeland and wildlife habitat. Deer and turkey are abundant.

The potential is low for cultivated farm and specialty crops. The slope, the very shallow root zone, and the hazard of water erosion restrict use of the soil to rangeland. Sorghum and small grain for grazing and hay are grown on a few small areas of the included soils.

The potential range production is low. The low rainfall, the very low available water capacity, and the restricted root zone all reduce the volume of forage produced. There is, however, a wide variety of plants which provide good quality food supplies for a wide variety of animals.

The potential for urban use is low. The slope, the shallowness over limestone bedrock, the difficulty in excavating the bedrock, and the risk of corrosion to uncoated steel are the most limiting features. Use for recreation facilities, such as campsites and playgrounds, is limited by the slope and the limestone fragments at the surface.

2. Tobosa-Vatera-Mereta

Deep to shallow clays and clay loams that are nearly level

The characteristic landscape of this unit is a broad, high plateau supporting shrubs and mesquite trees (fig. 3). The slope is no more than 3 percent.

***Figure* 3.—Typical landscape in the Tobosa-Valera-Mereta unit.**

This unit makes up 31 percent of the county. It is 37 percent Tobosa soils, 16 percent Valera soils, 14 percent Mereta soils, and 33 percent other soils.

Tobosa soils are dark grayish brown and dark brown, moderately alkaline clays. They are about 60 inches deep over limestone. Valera soils are very dark grayish brown and brown, moderately alkaline clays that are about 40 inches deep over caliche and limestone.

Mereta soils are grayish brown and brown, moderately alkaline clay beams that are about 16 inches deep over caliche.

Also in this unit are Cho, Ector, Kavett, Lipan, and Tarrant soils. Cho soils are gravelly and loamy and are very shallow over caliche. Ector and Tarrant soils are very shallow over limestone. Kavett soils are clayey. They are shallow over hard limestone. Lipan soils are deep clays in depressions.

This unit is mostly rangeland, but it also includes most of the cropland in the county. The major game is dove and quail.

The potential production on rangeland is medium. Low rainfall and the very low available water capacity in some of the soils are the main causes of the moderate forage yield.

The potential for crops is medium. It is high on Tobosa and Valera soils, which make up 53 percent of the unit, but it is low on some of the shallow or very shallow closely associated soils. Because most of the soils in this unit are clayey, they are difficult to keep in good tilth. Cotton, grain sorghum, forage sorghum, wheat, oats, barley, and vegetables are grown.

The potential for urban use is low. Shrinking and swelling with changes in moisture, very slow and moderately slow permeability, and the risk of corrosion to uncoated steel are the main limitations. The shallowness of Mereta soils and the moderate depth of Valera soils are also limitations. The potential is low for recreation facilities because of very slow and moderately slow permeability and clayey texture.

3. Angelo

Deep silty clay loarns that are nearly level

The typical landscape of this unit is flat valley floors supporting mesquite trees (fig. 4). The slope is no more than 1 percent.

***Figure* 4.—Typical landscape of the Angelo unit is in the foreground. The Tarrant-Ector unit is in the background.**

This unit makes up 9 percent of the county. It is 78 percent Angelo soils and 22 percent other soils.

The Angelo soils are brownish and moderately alkaline. They are silty clay loam to 3 inches, silty clay from 3 to 34 inches, and silty clay loam below 34 inches. A distinct layer of calcium carbonate accumulation begins at a depth of about 34 inches. Angelo soils are not generally subject to flooding.

Other soils included are the Cho, Dev, Ector, Rioconcho, and Tarrant soils. Cho, Ector, and Tarrant soils are very shallow, are more sloping than Angelo soils, and are higher in elevation. Dev and Rioconcho soils, which are lower than Angelo soils, are in or adjacent to stream channels and are subject to flooding.

This unit is mainly rangeland and wildlife habitat. Some larger areas of Angelo and Rioconcho soils, however, are well suited to cultivation, and a small acreage is cultivated. Deer, turkey, dove, quail, and, in some places, peccaries are important game animals.

The potential for cultivated crops is high. Cotton, grain sorghum, forage and hay crops, wheat, oats, and barley all do well on these soils. Some areas, however, are long narrow strips, and others are subject to frequent flooding. Pecan trees can be grown in some areas.

The potential for range is high. This unit receives some runoff from higher soils. Native range plants are short and mid grasses on the uplands and tall grasses on the bottom lands.

The potential for most urban uses is low. Shrinking and swelling with changes in moisture, risk of corrosion to uncoated steel, moderately slow permeability, and flooding are the main limiting features. The potential for recreation use is low because of moderately slow permeability and clayey texture.

Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a *soil series.* Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Some map units are made up of two or more major soils. These map units are called soil associations.

A soil association is made up of two or more geographically associated soils that are shown as one unit on the maps. Because of present or anticipated soil uses in the survey area, it was not considered practical or necessary to map the soils separately. The pattern and relative proportion of the soils are somewhat similar. The Dev-Rioconcho association, frequently flooded, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

Table 2 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Soil descriptions

1—Angelo silty clay loam, 0 to 1 percent slopes. This deep, nearly level soil is in valleys. It occurs as long, narrow strips parallel to the streams.

Typically the surface layer is dark grayish brown, moderately alkaline, and about 14 inches thick. It is 3 inches of silty clay loam over silty clay. From 14 to 34 inches is brown, moderately alkaline silty clay. From 34 to 60 inches is brown, moderately alkaline silty clay loam that is about 20 percent visible calcium carbonate (fig. 5). The underlying material to 80 inches is brown, moderately alkaline silty clay loam.

This soil is well drained. Permeability is moderately slow. The available water capacity is high. Runoff is slow. The root zone is deep, and the soil is easily penetrated by plant roots. The hazards of soil blowing and water erosion are slight.

***Figure* 5.—Angelo silty clay loam, 0 to 1 percent slopes. The whitish zone is accumulated calcium carbonate. It typically begins at 34 inches.**

Included in mapping are small areas of more sloping Angelo soils, Dev soils, and Rioconcho soils. These soils make up as much as 10 percent of any mapped area. Also included is a soil that is similar to the Angelo soil but has very gravelly layers below 30 inches. Included soils make up about 25 percent of any mapped area.

About 10 percent of the acreage of this Angelo soil is cropland. The rest is rangeland and wildlife habitat.

The potential is high for cropland. About one-half the acreage could be converted to cropland, but in many places it is in narrow strips and irregular shapes or is cut by too many drainageways. Crop residue left on the surface reduces evaporation, soil temperature, runoff, and erosion. Terraces between the cropland and higher, sloping soils are needed to prevent gullying.

The potential is high for rangeland. Most areas receive and absorb some runoff from adjacent hills, partly offsetting the low rainfall in the region. Controlling mesquite and maintaining an adequate plant cover are the main management problems.

The potential for most urban use is low. The Angelo soil shrinks and swells with changes in moisture, has a moderately slow water intake rate, and is moderately corrosive to uncoated steel. In spite of these limitations, it is one of the best soils in the county for urban use. The moderately high shrink-swell potential and the risk of corrosion can be overcome by good design. The moderately slow permeability makes large filter fields necessary for septic tanks.

The capability classification is IIIc nonirrigated and I irrigated. The range site is Clay Loam.

2—Cho association, undulating. This association is on weakly convex uplands and foot slopes. The slope range is 1 to 8 percent. The areas are irregular in shape and range from 8 to several thousand acres.

This association is about 65 percent Cho soil and 35 percent other soils. Most areas are large and variable. The detail in mapping, however, is adequate for the expected use of the soils.

Typically the Cho soil is dark grayish brown clay loam that is 9 inches thick over indurated caliche. The calcium carbonate content is very high. The gravel and cobble content, which increases with increasing depth, ranges from 2 to 30 percent. The indurated caliche layer is platy and is 1 to 10 inches thick. The underlying material is softer caliche or marl.

The Cho soil is well drained. Permeability is moderate. Runoff is medium. The available water capacity is very low. The soil blowing hazard is low, but because of the slope, the water erosion hazard is moderate.

Other soils in this association are Angelo, Mereta, and Valera soils, a soil that is similar to Cho but has a lower content of carbonates, and a soil that is similar to Cho but more clayey.

The Cho soil is not suitable for cultivation because of the slope, the very low available water capacity, the very shallow root zone, and the water erosion hazard.

This soil is used mainly as rangeland, but the potential range production is low. The typical woody vegetation is shrubs and a few mesquite on uplands and large live oak trees on foot slopes (fig. 6). Maintaining adequate cover to reduce runoff, soil temperature, evaporation, and erosion is the main management concern.

***Figure* 6.—Large live oak trees can grow in the soils of the Cho association, undulating, because their roots can penetrate deep into the underlying marl. The marl is exposed in the shallow pit in the foreground.**

The potential for most urban uses is low because of shallowness over indurated caliche. Excavation is difficult, the percolation rate through the indurated layer is very slow, and land leveling is difficult. Septic tank filter fields must be placed below the indurated layer. The underlying caliche or marl is well suited to roads. Nearly all the caliche sites in the county are in the Cho soil.

The capability subclass is VIs nonirrigated. The range site is Very Shallow.

3—Dev-Rioconcho association, frequently flooded. These are deep, bottom land soils subject to flooding. Typically they occur as long, narrow strips parallel to the larger intermittent streams. Most of these strips are several hundred acres. The slope range is 0 to 3 percent, but a few small areas of very steep soils on streambanks also occur.

A typical area is about 53 percent Dev soils, 23 percent Rioconcho soils, and 24 percent stream channels and other soils. Areas of this unit are mostly large and variable. The detail in mapping, however, is adequate for the expected use of the soils.

These soils are flooded once or twice each year. Rarely does the flooding last more than 1 day. The Dev soil typically is adjacent to the stream channel (fig. 7). On the Dev soil flooding may occur as often as 10 times a year in the lower areas and once in 10 years in areas where the channel is deeply entrenched. The Rioconcho soil, typically at slightly higher elevations, is not flooded so often.

***Figure* 7.—Dev very gravelly clay loam is more than 35 percent gravel and cobbles.**

Typically the Dev soil has a dark grayish brown, moderately alkaline very gravelly clay loam surface layer that is 30 inches thick and is 60 percent rounded limestone pebbles and cobbles. From 30 inches to about 80 inches is brown, moderately alkaline very gravelly clay loam that is 60 percent rounded limestone pebbles and cobbles.

This soil is well drained. Permeability is moderately rapid. The available water capacity is low. Runoff is medium. The hazards of soil blowing and water erosion are slight.

The Rioconcho soil has a dark gray or dark grayish brown, moderately alkaline clay loam surface layer 40 inches thick. From 40 to 80 inches is grayish brown, moderately alkaline clay loam that in places is stratified with limestone gravel.

This soil is well drained. Permeability is slow. The available water capacity is high. Runoff is slow. The risks of soil blowing and water erosion are low.

Included in this association are small areas of Angelo silty clay loam, stream channels, and recent stratified material. The stream channels are mostly limestone rubble. In places they are nearly solid limestone bedrock. The recent stratified material includes loams, clay loams, and silt loams and varying amounts of gravel. Stratification and other evidence of recent deposition are obvious.

Dev and Rioconcho soils are not suitable for cultivation because of the flood hazard and the high gravel content of the Dev soils. Nearly all the acreage is rangeland. The rangeland is highly productive because the floodwater is beneficial to forage plants and some trees. Pecan groves are along some of the larger streams, and in other places pecan orchards could be planted. Permanent cover is needed in orchards to protect the soil from erosion during floods. Houses and other structures should not be built on these soils because of the flood hazard.

The capability subclass is Vlw nonirrigated for the Dev soil and Vw nonirrigated for the Rioconcho soil. The range site is Draw for the Dev soil and Loamy Bottom Land for the Rioconcho soil.

4—Ector association, undulating. This association consists of very shallow soils on low rounded hills that have convex slopes. The slope range is 1 to 8 percent. The areas are irregular in shape and are about 100 to more than 1,000 acres. The Ector soil has a surface layer of very gravelly loam, clay loam, or silt loam. The rock fragments are limestone or hard caliche. In some places they are mostly cobbles.

This association is about 75 percent Ector soil and 25 percent other soils. The areas are large and variable. The detail in mapping, however, is adequate for the expected use of the soils.

Typically the Ector soil has a surface layer of dark grayish brown, moderately alkaline very gravelly clay loam about 8 inches thick. Hard caliche fragments and limestone fragments make up 70 percent of this layer. Caliche coated limestone underlies the surface layer (fig. 8). The cracks in the limestone are sealed with caliche.

The Ector soil is well drained. Permeability is moderate. Runoff is rapid. The available water capacity is very low. The root zone is very shallow. The water erosion hazard is moderate, and the soil blowing hazard is slight.

Other soils in this association are Angelo, Cho, and Tarrant soils and a soil that is similar to Ector but has an indurated caliche layer more than 1 inch thick over limestone.

The potential is low for cultivation because of the slope, the very shallow root zone, and the erosion hazard. Nearly all of this soil is rangeland. The typical woody vegetation is juniper, a few mesquite, and several species of shrubs. Oaks do not grow in this soil. Because cracks in the underlying limestone are sealed with hard caliche, areas of Ector soil probably contribute very little to underground water supplies. Range production is low but includes a moderately wide variety of forbs and grasses. Removing juniper and

***Figure* 8.—The Ector soil in this roadside ditch was washed away, exposing the hard caliche coating that seals the underlying limestone.**

maintaining adequate cover to reduce runoff, soil temperature, evaporation, and erosion are the main management problems. The Ector soil provides good habitat for white-tailed deer and turkey.

The potential is low for most urban uses. Slope, small stones on the surface, shallowness over bedrock, and risk of corrosion to uncoated steel are the most limiting features.

The capability subclass is VIIs. The range site is Limestone Hill.

5—Kavett-Tarrant association, nearly level. This association consists of shallow and very shallow soils on uplands. Slopes are no more than 3 percent and are mainly less than 1 percent. The areas are irregular in shape and range from 10 to 1,000 acres.

This association is about 40 percent Kavett soil, 35 percent Tarrant soil, and 25 percent other soils. Most areas are large and variable. The detail in mapping, however, is adequate for the expected use of the soils.

Typically the Kavett soil has a surface layer of dark grayish brown, moderately alkaline clay about 14 inches thick. Below this is indurated caliche on hard limestone.

The Kavett soil is well drained. Permeability is moderately slow. The available water capacity is very low. Runoff is slow. The root zone is restricted by rock. The hazard of soil blowing or water erosion is slight.

Typically the Tarrant soil has a surface layer of very dark grayish brown, moderately alkaline very gravelly clay about 9 inches thick. Cobbles and pebbles make up 50 percent of this layer. At the surface, cobbles are about 5 feet apart, and stones are 30 feet apart. Fractured hard limestone is below 9 inches.

The Tarrant soil is well drained. Permeability is moderately slow. Runoff is rapid. The available water capacity is very low. The root zone is restricted by rock, but water and some live oak roots extend deep into cracks in the rock. The hazard of soil blowing or water erosion is slight.

Other soils in this association are small areas of Angelo, Mereta, and Valera soils. These soils make up about 25 percent of any mapped area.

The potential for cropland is low because the nonarable Tarrant soil is associated with the deeper Kavett soil. The Kavett soil is suitable for cultivation but occurs in areas that are too small to be cultivated profitably. These areas do, however, make good deer forage plots if planted to winter oats, barley, wheat, or alfalfa.

The potential range production is medium. Woody vegetation consists of mesquite on the Kavett soil and live oak on the Tarrant soil (fig. 9). Maintaining adequate cover to reduce runoff, soil temperature, evaporation, and erosion is the main management concern.

The potential is low for most urban uses. The water intake rate in septic tank filter fields is slow. Excavation is very difficult. Foundations must be set into the bedrock. The soil is sticky during rainy periods.

The capability subclass is IIIe for the Kavett soil and VIIs for the Tarrant soil. The range site is Shallow for the Kavett soil and Low Stony Hills for the Tarrant soil.

***Figure* 9.—Mesquite and live oak trees in an area of the Kavett-Tarrant association, nearly level.**

6—Lipan clay. This soil is in nearly level and concave areas that are temporary lakes during rainy periods (fig. 10). Slopes are no more than 1 percent, and are mainly less than 0.5 percent. The areas are nearly round and range from 6 to 70 acres. They are 3 to 15 feet lower than the surrounding soils. In unplowed areas the surface of this soil has small rounded depressions or shallow trenches that are about 9 to 30 feet across and a few inches to 20 inches deep. These small depressions are destroyed after a few years of cultivation.

***Figure* 10.—Temporary lake in an area at Lipan clay.**

Typically the Lipan soil is gray, moderately alkaline clay to 65 inches. From 65 to 69 inches is grayish brown, moderately alkaline clay with accumulations of calcium carbonate. Hard limestone is below 69 inches. The gray color results from periodic flooding and the resulting poor aeration.

This soil is somewhat poorly drained. Surface runoff from higher soils ponds to a depth of 1 to 10 feet during rainy periods. This ponding may last from a few weeks to more than a year. When the soil is dry, it has cracks about 3 inches wide. While the cracks are open, the water intake rate is rapid, but as the soil is moistened, it swells, and the cracks close. The intake rate then becomes very slow. The available water capacity is high.

Maintaining good tilth is difficult in cultivated areas. The soil is difficult to plow when it is very dry, and if it is plowed too wet the high clay content causes puddling.

Included with this soil in mapping are small areas of Tobosa clay and small areas of a soil that is similar to Lipan clay but is darker. A stony phase of Lipan is also included. The stones are 1 to 6 feet across and 2 to 50 feet apart. Few to many stones occur in about one-third the acreage of Lipan soils. Included soils make up about 15 percent of any mapped area.

About 20 percent of the Lipan soil is cropland. The rest is rangeland and wildlife habitat.

The potential for crops is low. The most successful crops are cotton, grain, and forage sorghum. Planting and harvesting are delayed in some years by ponding. For consistently good crops, control of excess water is needed. Potential is high where excess water is con-trolled. Ponding can be controlled by level terraces on the surrounding soils. Some areas can be drained by drilling holes to underground cavities. Crop residue on the soil surface reduces soil temperature and evaporation.

The potential range production is medium. Ponding drowns some plants. The duration of flooding and the forage production can be estimated by the variety of plants. The areas with the fewest kinds of plants are flooded for the greatest length of time.

Migratory wildlife is greatly benefited by the temporary lakes on Lipan soil. Waterfowl use the open-water areas, shore birds use the mud flats exposed by the receding shoreline, and seed-eating birds feed on the sunflowers and other plants that spring up after the lakes go dry.

The potential for urbanization is low. Flooding, shrinking and swelling with changes in moisture, and risk of corrosion to uncoated steel are the most restrictive features.

The capability subclass is IVw nonirrigated and IIs irrigated. The range site is Lakebed.

7—Rioconcho clay loam, occasionally flooded. This deep, nearly level soil is on bottom lands. It is adjacent to the larger streams in the eastern part of the county. Flooding is expected once in 10 to 50 years. Slopes are no more than 1 percent.

Typically this soil has a surface layer of dark gray, moderately alkaline clay loam about 20 inches thick. From 20 to 40 inches is dark grayish brown, moderately alkaline clay loam. From 40 to 60 inches is grayish brown, moderately alkaline clay loam. From 60 to 80 inches is rounded limestone gravel.

This soil is moderately well drained. Runoff and permeability are slow. The available water capacity is high. The root zone is deep. The hazard of water erosion or soil blowing is slight. In some places a water table occurs at a depth that can be reached by tree roots, so large trees like pecan, elm, live oak, bur oak, and chinkapin oak grow well.

Included with this soil in mapping is a soil that is similar to Rioconcho but has a zone of calcium carbonate accumulation. Also included are some Rioconcho soils that do not have gravel strata at 60 inches. These included soils make up about 15 percent of any mapped area.

About 40 percent of this Rioconcho soil is cropland. The rest is rangeland or naturally-occurring pecan groves that are grazed.

The potential is high for cultivated crops. The main crop is livestock forage for grazing and hay. Crop residue on the surface reduces evaporation, soil temperature, and erosion.

Pecan orchards would do well on all of these areas because the soil is deep and friable and because flooding benefits established trees (fig. 11). Plant cover is needed in pecan orchards.

As rangeland, Rioconcho soil is very productive for a wide variety of plants. Plants benefit from the occasional flooding, and there is a water table within reach of tree roots. Flooding also improves the habitat for game fish by removing organic material accumulations in the stream and by creating sand and gravel areas for spawning.

The potential for urban use is low because of flooding, shrinking and swelling with changes in moisture, and risk of corrosion to uncoated steel.

The capability classification is IIc nonirrigated and I irrigated. The range site is Loamy Bottom Land.

Figure **11.—Pecan trees in an area of Rioconcho clay loam, occasionally flooded.**

8—Tarrant association, undulating. This association consists of very shallow cobbly and stony soils on lime-stone hills. The slope range is 1 to 8 percent. The Tarrant soil is the most extensive soil in the county. The areas are irregular in shape and range from about 100 to more than 1,000 acres.

This association is about 75 percent Tarrant soil and 25 percent other soils. The areas are large and variable. The detail in mapping, however, is adequate for the expected use of the soil.

Typically the Tarrant soil is dark grayish brown, moderately alkaline cobbly clay 10 inches thick over fractured limestone.

The Tarrant soil is well drained. Permeability is moderately slow. The available water capacity is very low. Runoff is rapid.

Other soils in this association are Cho, Ector, and Kavett soils and areas of Rock outcrop, which make up about 12 percent of any mapped area. Also included are areas of a soil that is similar to Tarrant but has a hard caliche layer over limestone. Included soils and Rock outcrop make up as much as 25 percent of any mapped area.

This association is used as rangeland and as wildlife habitat. The potential for cultivation is low. The association supports a wide variety of plants, including many desirable evergreen woody plants and forbs. The typical woody vegetation is many small live oak trees and some juniper. Oaks grow on this soil because their roots are able to penetrate deep into the underlying limestone. Cracks in the limestone are not sealed, and water and oak roots can be more than 20 feet deep.

This soil is probably the most important soil in underground water recharge. Ground water collects in the cracks between the limestone fragments. Because of the slope and the very low water storage, water erosion is moderate when the soil is bare. Erosion damage is costly because the soil is very shallow. The damage is nearly permanent because new soil forms very slowly from hard limestone. Maintaining adequate cover to reduce runoff, soil temperature, evaporation, and erosion is the main management concern.

The wide variety of vegetation on this soil provides excellent habitat for deer, turkey, many songbirds, and many kinds of small wildlife.

The potential is low for urban use. The depth to rock and the slope are the most restrictive features.

The capability subclass is VIIs. The range site is Low Stony Hills.

9—Tarrant association, hilly. This association is on the sides of the steepest limestone hills in the county. The slope range is 10 to 30 percent. The areas are very irregular in shape and are mostly several hundred acres.

This association is about 80 percent Tarrant soil and 20 percent other soils. The areas are large and variable. The detail in mapping, however, is adequate for the expected use of the soil.

Typically the Tarrant soil is dark grayish brown, moderately alkaline cobbly silty clay 11 inches thick over fractured limestone.

The Tarrant soil is well drained. Permeability is moderately slow. The available water capacity is very low. Runoff is rapid. The hazard of water erosion is severe because of the steep slopes.

Other soils in this association are the Cho and Ector soils and a soil that is similar to the Tarrant soil but in which the fractures in the underlying limestone are filled with hard caliche.

This association is used as rangeland and as wildlife habitat. The potential for cultivation is low. A wider variety of woody plants grows on this soil than on the less sloping Tarrant soils (fig. 12). The wide variety of vegetation provides excellent habitat for deer, turkey, and many kinds of smaller wildlife. Maintaining a plant cover at all times is very important. Reducing runoff, soil temperature, evaporation, and erosion are the main management problems.

***Figure* 12.—Tarrant association, hilly, supports a variety of woody plants.**

The potential is low for urban use. Shallowness over rock and the steep slopes are the most restrictive features.

The capability subclass is VIIs. The range site is Steep Rocky.

10—Tobosa clay, 0 to 1 percent slopes. This deep, nearly level soil is on divides. The slopes are slightly concave but only a few inches lower than the surrounding soils. This soil is covered by water for short periods during seasons of high rainfall. The areas are irregular in shape and range from 10 to 500 acres.

Typically, the Tobosa soil has a surface layer of dark grayish brown, moderately alkaline clay 24 inches thick. From 24 to 50 inches is dark brown, moderately alkaline clay. From 50 to 58 inches is brown, moderately alkaline clay and a few soft masses of calcium carbonate. Hard limestone underlies this layer.

The Tobosa soil is well drained. Many areas receive water from surrounding soils, which are a few inches higher. When the soil is dry, cracks 3 inches wide extend to a depth of 40 inches or more. Water enters the soil rapidly when the cracks are open, but as the soil is moistened it swells, and the cracks close. Permeability then becomes very slow. The available water capacity is medium. The root zone is deep, but the high clay content tends to impede the movement of air and roots. Maintaining good tilth is difficult in cultivated areas. Hard clods form if the soil is plowed when too wet. The soil is difficult to plow when it is very dry. The water erosion hazard is slight, and the soil blowing hazard is moderate.

Included with this soil in mapping are a soil that is similar but is stony and a soil that is similar but is only 32 to 40 inches thick over hard limestone. Included soils make up about 20 percent of any mapped area.

About 25 percent of this soil is cropland. The rest is mostly rangeland.

The potential for cropland is high. Most areas of this soil are associated with other arable soils and could be converted to cropland. Conserving moisture and maintaining good tilth are the main management concerns. Crop residue left on the surface reduces evaporation, slows runoff, reduces soil temperature, and helps to maintain tilth. The main crops are cotton, grain sorghum, forage sorghum, wheat, oats, and barley.

The potential range production is medium because the high clay content restricts vegetation to several moderately productive species. Mesquite trees have increased in most areas and are a major management problem (fig. 13).

The potential for most urban uses is low. Shrinking and swelling with changes in moisture and the risk of corrosion to uncoated steel are the main limiting features. Septic tank filter fields must be very large because the infiltration rate is very slow.

The capability subclass is IIIs nonirrigated and IIs irrigated. The range site is Clay Flat.

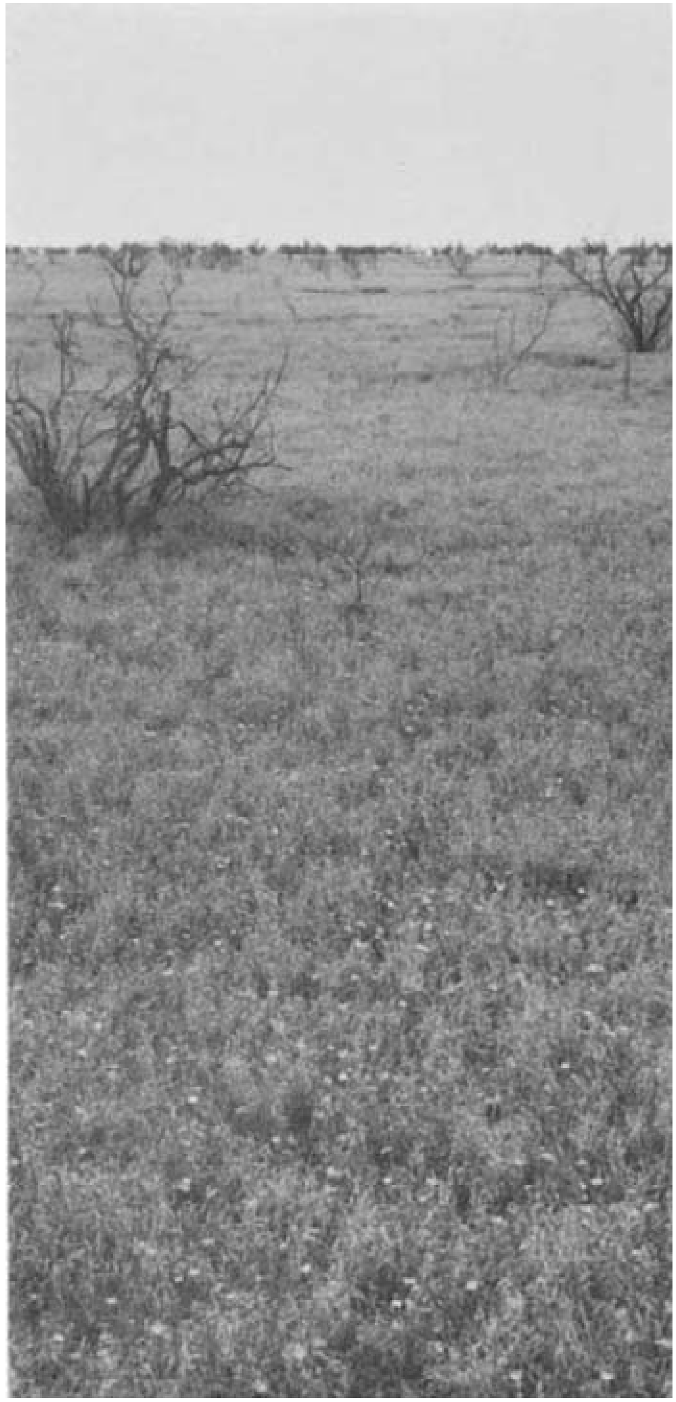


***Figure* 13.—Mesquite trees and tobosa grass in an area of Tobosa clay. The dense stand of tobosa grass is typical in the western part of the county.**

11—Valera-Mereta-Kavett association, nearly level. This association consists of shallow to moderately deep soils on uplands. Slopes, which are typically slightly convex, are no more than 3 percent. Areas are 40 to more than 1,000 acres.

This association is 30 percent Valera clay, 26 percent Mereta clay loam, 17 percent Kavett clay, and 27 percent other soils. Areas of this unit are large and variable. The detail in mapping, however, is adequate for the expected use of the soils.

The Valera soil typically has a very dark grayish brown, moderately alkaline clay surface layer about 10 inches thick. From 10 to 32 inches is dark grayish brown, moderately alkaline clay. From 32 to 40 inches is brown, moderately alkaline clay that is about 15 percent caliche masses and limestone fragments. From 40 to 42 inches is indurated caliche. Below 42 inches is hard limestone.

The Valera soil is well drained. Permeability is moderately slow. The available water capacity is medium. Runoff is slow.

The Mereta soil has a grayish brown, moderately alkaline clay loam surface layer 10 inches thick. From 10 to 16 inches is brown, moderately alkaline clay loam. From 16 to 25 inches is platy indurated caliche. Below 25 inches is soft caliche and marl.

The Mereta soil is well drained. Runoff is slow. Permeability is moderately slow. The available water capacity is very low.

The Kavett soil has a 14-inch surface layer of dark grayish brown, moderately alkaline clay that is 15 percent platy, caliche-coated limestone fragments 1/4 inch to 8 inches across. From 14 to 18 inches is white, flattened indurated caliche nodules and plates. A continuous coating of hard caliche is on the underlying limestone.

The Kavett soil is well drained. Permeability is moderately slow. The available water capacity is very low. Runoff is slow.

Included in mapping are small areas of Cho, Ector, Tarrant, and Tobosa soils, a soil that is similar to Valera but has a light colored surface layer, and a soil that is similar to Mereta but has no calcium carbonate accumulation.

The potential for cropland is medium. Crops are grown on 3 percent of the association. Cotton, grain sorghum, forage sorghum, wheat, oats, and barley are grown successfully. Crop residue left on the surface reduces the risk of water erosion and soil blowing and conserves moisture. Field terraces reduce runoff.

The potential for rangeland is medium. Control of mesquite trees and pricklypear cactus is a major expense to ranchers.

The potential for most urban use is low. Shrinking and swelling with changes in moisture, high risk of corrosion to uncoated steel, and shallowness over rock are limitations. Large septic tank filter fields are needed because permeability is moderately slow.

The capability subclass is IIe for the Valera soil and IIIe for the Mereta and Kavett soils. The range site is Clay Loam for the Valera soil and Shallow for the Mereta and Kavett soils.

Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The acreage of cropland is about 38,000. About 2,600 acres was irrigated in 1974, according to a survey of irrigated land by the Soil Conservation Service.

The most restrictive feature for crops is low rainfall. The potential for increased production is high, but the low rainfall restricts many of the soils to rangeland.

Other management problems are the hazards of water erosion and soil blowing.

Water erosion is a hazard in the larger areas and on the more sloping Angelo, Tobosa, Mereta, Valera, and Kavett soils. Runoff can damage these soils unless they are protected. Plant cover, contour farming, terraces, and grassed waterways help to minimize the risk of water erosion.

Soil blowing is a moderate hazard during periods of severe drought. It is most severe on the clayey Lipan and Tobosa soils. It can damage these soils in a few hours if winds are strong and the soils are powdery and bare of plant cover or surface mulch. Maintaining plant cover, surface mulch, or a rough surface through proper tillage minimizes the risk of soil blowing.

Loss of the surface layer through water erosion or soil blowing is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging if the soil is shallow or the depth of the root zone is limited by a layer such as the indurated caliche layer in Mereta soils. Second, water erosion on farmland results in sedimentation of streams. Controlling water erosion minimizes the pollution of streams by sediment and improves the quality of water for urban use, recreation, and wildlife. Soil blowing results in pollution of the air and deposits drifts of productive soil material along fence rows and on roads.

Erosion control practices should provide protective surface cover, reduce runoff, and increase water intake. A cropping system that keeps a plant cover on the soil for long periods can hold erosion losses to amounts that will not reduce yields.

Minimum tillage and crop residue on or near the soil surface increase water intake and reduce the hazards of runoff and erosion. These practices can be adapted to most soils in the survey area but are difficult to use successfully on soils that have a very clayey surface layer, such as Lipan and Tobosa soils.

Emergency tillage helps to control soil blowing when crop residue does not furnish enough protection. Emergency tillage roughens the soil surface to slow the movement of the wind. Angelo, Valera, Lipan, Mereta, Kavett, and Tobosa soils are suitable for emergency tillage.

Contour farming is another erosion control practice used in the survey area. It is best adapted to short slopes and to soils with smooth, uniform slopes. Contour farming is needed in some areas of Angelo, Tobosa, Mereta, Valera, and Kavett soils and in all areas where there are field terraces.

Grassed waterways minimize the hazard of erosion by concentrated runoff. They are also good outlets for field terraces or diversion terraces.

Field terraces and diversion terraces reduce the length of slopes and slow runoff and erosion. Diversion terraces upslope from cropland divert runoff away from the cropland. Terraces are most practical on deep, well drained soils that have smooth slopes, such as Angelo, Tobosa, and Valera soils. Some other soils are less suitable because of irregular slopes or shallowness over hard caliche.

Information on designing erosion control practices for each kind of soil is available in local offices of the Soil Conservation Service.

Water control is needed on the somewhat poorly drained Lipan soils if they are used as cropland. In most areas excess water can be controlled by level terraces on the surrounding soils.

Soil fertility is naturally medium to high. Farm manure is best for maintaining or improving fertility. If large amounts are used, however, the following crop is damaged in drought years. Spreading the manure in a thin layer over large areas reduces the danger of damage from over fertilization. Applying commercial fertilizer to nonirrigated land improves yields. Fertilizing irrigated land increases yields substantially. Commercial fertilizer should be applied according to the results of soil tests, the need of the crop, and the expected level of yields. The Cooperative Extension Service can help in determining the kind and amount of fertilizer needed. The nutrients which have the greatest effect on yield are nitrogen, phosphorus, and iron. No lime is needed because large amounts occur naturally in all the soils.

Soil tilth is important in the germination of seeds and in the rate of water intake. Soils with good tilth are granular, porous, and friable. Tilth can be improved by adding large amounts of organic matter such as manure or crop residue. Because Lipan and Tobosa soils are high in clay, it is hard to keep them in good tilth. If plowed when wet, they tend to be cloddy when dry. Preparing a good seedbed is difficult in a cloddy soil. Fall plowing generally results in good tilth in spring, but soil blowing may be a problem if the soil is left bare.

The crops currently grown in Schleicher County are cotton, grain sorghum, wheat, oats, barley, hay and grazing crops, and a small acreage of vegetables. All would do better if irrigated. Because the volume of irrigation water is not great, the greatest potential increase in crops appears to be in irrigated vegetables. Deep soils that have good natural drainage and that warm up early in spring are especially well suited to many vegetables, for example, cantaloup, tomatoes, onions, squash, carrots, radishes, peppers, okra, beans, spinach, asparagus, eggplant, turnips, beets, and cucumbers. They are also well suited to some varieties of blackberries and grapes. Pecans are best suited to deep, well aerated soils that are deeply moistened by floodwater. Pecans are now growing on some of the Rioconcho and Dev soils. More pecan orchards could be planted. Pecan orchards are also suited to Angelo soils but require irrigation. Pecans grow slowly on Tobosa soils.

The latest information and suggestions on growing new crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Water for irrigation is not abundant, and the demand is constantly increasing. Because the energy to pump water is becoming more expensive, efficient irrigation is essential. Irrigation water should be used on the best soils. It should be applied uniformly, without water loss, in amounts and at intervals that promote adequate plant growth. Good irrigation wets the entire root zone so that most of the water is below the rapid evaporation area.

Sprinkler irrigation is not efficient in hot, dry areas. On some windy summer days 40 percent of the water pumped is lost to evaporation before it soaks into the soil. Some sprinkler systems wet only the surface layer where evaporation loss is great. Because sprinklers require water under pressure, pumping costs are greater than for surface irrigation. The advantage of sprinkler irrigation is that little land leveling is required.

Row irrigation or border irrigation is generally the most efficient. More labor and more land leveling, however, may be required.

The best soils for irrigation are level and have a deep root zone and high available water capacity. The best soils in Schleicher County are Rioconcho and Angelo soils. Lipan, Tobosa, Valera, Mereta, and Kavett soils are also suitable for irrigation but are less desirable.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 3. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include erosion control and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 3 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

Land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s, or c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s, or c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 4. The capability classification of each map unit is given in the section "Soil maps for detailed planning."

Rangeland

About 807,000 acres, or 94 percent of the county, was used as rangeland in 1967, according to the Conservation Needs Inventory (4). Most of the soils produce a mixture of woody plants, forbs, and grasses suitable for grazing by cattle, sheep, goats, and white-tailed deer.

There are about 100 ranches and livestock-producing farms. Livestock number about 30,000 cattle, 125,000 sheep, and 50,000 goats. Deer have increased in number and value. It is estimated that a deer uses about the same amount of forage as a goat.

Effective range management achieves maximum or near maximum production and conserves soil and water.

The major management problem on most of the rangeland is control of grazing animals so that the kinds and amounts of plants that make up the potential plant community are reestablished. Deferred grazing is needed so that plants can reproduce and maintain vigor. Half the annual forage production should be left.

Reducing undesirable or overabundant woody plants is also a major management problem. As early as the 1880's mesquite was invading the prairies in this part of the state. Mesquite is now abundant on all shallow and deeper soils, such as the Angelo, Tobosa, Valera, Mereta, and Kavett soils. Mesquite has a much deeper root system than grasses and withdraws moisture from a greater depth. It is reducing underground water recharge, is using much of the soil moisture that could be growing forage, and is making roundups difficult. The mesquite invasion is a major operating expense for ranchers (fig. 14).

***Figure* 14.—Mesquite trees and pricklypear cactus are a problem on much of the rangeland in the county. This is an area of the Clay Loam range site.**

Juniper has also increased greatly. It is most abundant on Ector sods, where roots cannot penetrate the underlying fractured limestone (fig. 15). Juniper can tolerate a shallow root zone. Few other large plants can. Live oak trees have increased on the Tarrant and Cho sods, where roots can penetrate the underground limestone or marl. Because the evergreen leaves and acorns are used by deer and goats, the increase is considered beneficial by ranchers who favor those animals. Pricklypear cactus has also increased. It is most abundant on the deeper soils. Removing it is expensive**.**

Plant growth is greatest during April, May, and June; a lesser growth period occurs in September and October.

All are months of high rainfall; May is the highest with an average of 3 inches. and September is second with 2 inches. Angelo, Lipan, and Rioconcho sods can store these large amounts of water.

***Figure* 15.—Juniper is abundant on Ector soils. These soils are in the Limestone Hill range site.**

Animals need forage containing moderate to high amounts of protein. Protein content is highest in green plants. Because most plants grow in summer, the protein need is most difficult to fill in winter. Therefore, soils that support evergreen plants or cool season plants are important. As much as 21 percent of the total production on Rioconcho and Dev soils is evergreen forbs, live oak trees, Canada wildrye, and Texas wintergrass. Tarrant soils support a wide variety of plants, including many that are evergreen or cool season. In many places juniper and live oak are overabundant on these soils. The green winter forage, therefore, varies from 10 to 50 percent.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to differences in the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 5 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Explanation of the column headings in table 5 follows.

A range site is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals.

It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition,* the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Gardening and landscaping

Landscaping is easier if as much of the natural topography and vegetation as possible is preserved during construction. Large cuts and fills are difficult to protect from erosion and difficult to hide. Cuts in Tarrant and Ector soils are especially hard to cover. Large fills are poor foundations, and too much fill over tree roots may kill the tree.

Most yard and garden plants do best in soils that are moist, deep, friable, loamy, and fertile. Because garden areas are small, unfavorable soil characteristics can generally be modified. The hard-to-till clayey surface layer of Tobosa, Valera, and Kavett soils can be mellowed by working in organic material such as compost, manure, or grass clippings. Working organic material deep into the soil helps to relieve internal drainage problems caused by a dense clay subsoil, as in the Tobosa soil.

The depth of the root zone and the large amount of lime in the soils are the two most important characteristics that affect suitability. Large plants such as pecan, pear, bur oak, chinkapin oak, plum, desert willow, sunflower, and agave require less care if they are planted in the deep Angelo, Dev, or Rioconcho soils. Native plants are easiest to grow because they are suited to the soils.

Yellowing, although sometimes a symptom of disease, generally indicates that fertilizer is needed. Fertilizer should be added according to the results of soil tests. If tests are not made, the following general guidelines may be used.

No lime is needed. All soils in this county have an abundant supply of calcium carbonate. The pH of all the soils is near 8.0.

Nitrogen is the main fertilizer needed on lawns. Plants need large amounts of nitrogen to grow rapidly and to keep a dark green color.

Phosphorus is needed to insure good seed or fruit production. Phosphorus plus nitrogen is usually best for gardens. Phosphorus readily reacts with the calcium compounds in all Schleicher County soils, forming compounds in which the phosphorus is unavailable to plants. To insure an adequate supply of phosphorus, it must be added in great quantities or applied in pellet form or as a concentrated band.

Most soils here have an adequate supply of potassium, but potassium can be added conveniently by spreading fireplace ashes.

Adequate amounts of the trace elements, such as boron, copper, zinc, iron, and manganese, are generally present in all the soils or are supplied by an occasional application of manure. Amounts of zinc and iron are not adequate for all plants.

Pecan trees in moderately alkaline soils may need zinc. Periodic foliage sprays containing zinc are the only effective treatment.

Peaches, pyracanthas, roses, blackberries, pears, strawberries, beans, black-eyed peas, and St. Augustine grass may have an iron deficiency. Much iron is in all the soils here, but like phosphorus, iron may form compounds that plants cannot utilize. Iron deficiency is most likely to be a problem in Mereta and Cho soils. The cure is difficult or drastic. Iron can be supplied by iron chelates in foliage sprays, by iron sulfate or iron chelates in the soil, or by driving rusty nails into tree trunks. The last treatment is long lasting and in some instances works well. Sprays on foliage are effective but must be repeated after rain and when new foliage develops. Soil treatment with iron is typically done annually. In calcareous soil, iron sulfate is sometimes more effective if applied in concentrated bands and if the iron sulfate is mixed in about equal parts of sulfur and manure. Compost can be substituted for manure.

Recreation

The soils of the survey area are rated in table 6 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 6, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 6 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 9 and interpretations for dwellings without basements and for local roads and streets in table 8.

Camp areas require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife habitat

Frank Sprague, biologist, Soil Conservation Service, prepared this section.

Schleicher County is in a region noted for its excellent hunting opportunities. On many farms and ranches, wildlife habitat is improved by brush management and food plantings. Large numbers of hunters lease hunting rights from ranchers. The major game species are white-tailed deer and turkey. Javalina, dove, and quail are also abundant. Bobcat, coyote, raccoon, fox, skunk, ringtail, and oppossum are hunted or trapped for their pelts. Small mammals, reptiles, amphibians, and nongame birds are numerous.

The kind of wildlife that populates an area depends largely upon the abundance and distribution of food, cover, and water. Soils and climate affect the kind and amount of vegetation that is available to wildlife as food and cover. Soils and climate also affect water impoundments. If the soils have the potential, wildlife habitat can be created or improved by managing vegetation. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 7, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The ratings in table 7 take into account primarily the characteristics of the soils and closely related natural factors of the environment. They do not take into account climate, present use of soils, or present distribution of wildlife and population. For this reason, onsite inspection is required in selecting a site for development as wildlife habitat.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are wheat, oats, and grain sorghum.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are kleingrass and lovegrass.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are Englemann-daisy, bushsunflower, sideoats grama, and curlymesquite.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are skunkbush, kidneywood, elbowbush, and lotebush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, rushes, and sedges.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include quail, rabbit, dove, turkey, and songbirds.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, and shore birds.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include deer, turkey, raptors, furbearers, and coyotes.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on the observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data *generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building site development

Table 8 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

Sanitary facilities

Table 9 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 9 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 9 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 9 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction materials

Table 10 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill, sand, gravel, and topsoil. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 10 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel. None of the soils in Schleicher County are suitable sources of sand.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 12.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water management

Table 11 gives information on the soil properties and site features that affect water management. The kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; drainage; irrigation; terraces and diversions; and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted root zone, a severe hazard of wind or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of wind erosion, low available water capacity, a restricted root zone, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

Engineering properties and classifications

Table 12 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture (5). These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and chemical properties

Table 13 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture con-tent is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate,* 3 to 6 percent; and *high,* more than 6 percent. *Very high,* greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loans. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loans that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loans and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loans that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Soil and water features

Table 14 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams and by runoff from adjacent slopes. Water standing for short periods after rainfall or snowmelt is not considered flooding.

Table 14 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 14 are the depth to the seasonal high water table; the kind of water table that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 14.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Cemented pans are hard subsurface layers, within a depth of 5 or 6 feet, that are strongly compacted (indurated). Such pans cause difficulty in excavation. The hardness of pans is similar to that of bedrock. A rippable pan can be excavated but a hard pan generally requires blasting.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low, moderate,* or *high.* It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (6). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 15, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Vertisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustert (*Ust,* meaning dry, plus *ert,* from Vertisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Chromusterts *(Chrom,* meaning color, plus *ustert,* the suborder of the Vertisols that has an ustic moisture regime).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups.

Extra grades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Chromusterts.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, montmorillonitic, thermic Typic Chromusterts.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series. An example is the Tobosa series, a member of the fine, montmorillonitic, thermic family of Typic Chromusterts.

Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (5). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (6). Unless otherwise stated, colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

Angelo series

The Angelo series consists of deep loamy soils that formed in old alluvial material. These soils are on valley floors that are above overflow. Slopes are no more than 2 percent.

Typical pedon of Angelo silty clay loam, 0 to 1 percent slopes; 10.2 miles north of the Schleicher County Courthouse on U.S. Highway 277, 1.0 mile west on a ranch road, and 300 feet south in an area of rangeland:

A11—0 to 3 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate very fine subangular blocky; very hard, firm, slightly plastic; many fine roots; the upper one-half inch is weak thin platy; calcareous; moderately alkaline; clear smooth boundary.

A12—3 to 14 inches; dark grayish brown (10YR 4/2) silty clay very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate very fine to fine subangular blocky; extremely hard, very firm; many fine roots; few worm casts; few small limestone pebbles; calcareous; moderately alkaline; gradual wavy boundary.

B21—14 to 34 inches; brown (7.5YR 5/4) silty clay, dark brown (7.5YR 4/4) moist; moderate fine to medium blocky structure; extremely hard, very firm, common fine roots; few fine pores; few worm casts; few small limestone pebbles; few vertical streaks of darker soil one-quarter inch wide; vertical cracks 6 to 10 inches apart; some wedge-shaped peds; calcareous; moderately alkaline; clear wavy boundary.

B22ca—34 to 60 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate fine to medium blocky structure; very hard, firm; few fine roots; 15 percent caliche coated limestone pebbles, 5 percent caliche concretions, and 5 percent soft calcium carbonate masses; calcareous; moderately alkaline; gradual wavy boundary.

B23ca—60 to 80 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; weak fine to medium subangular blocky structure; very hard, firm, slightly plastic; 5 to 10 percent rounded caliche coated limestone pebbles; calcareous; moderately alkaline.

The solum is 60 to more than 100 inches thick. It is calcareous and is more than 35 percent clay. Distinct calcium carbonate accumulations begin at a depth of 24 to 40 inches.

The A horizon ranges from 10 to 20 inches in thickness. It is grayish brown or dark grayish brown. The most silt is typically in the upper few inches.

The B21 horizon ranges from 10 to 34 inches in thickness. It is brown, dark brown, or light brown. The texture is silty clay, clay, or clay loam.

The Bca horizon is typically 6 to 34 inches thick but is as much as 60 inches thick in some pedons. Visible calcium carbonate makes up 10 to 60 percent of the horizon. Some is powdery coatings, some is concretions from 1 millimeter to 1 inch in diameter, and some is indurated coatings on pebbles. The color is light brown, brown, pink, or reddish yellow. The texture is silty clay loam or silty clay. Most pedons have waterworn pebbles in this horizon, and some pedons also have cobbles and stones.

Cho series

The Cho series consists of gravelly and loamy soils that are very shallow over indurated caliche (fig. 16).

These soils formed in highly calcareous materials. They are on the broad, nearly level divide or at the base of undulating hills. The slope range is 1 to 8 percent.

Typical pedon of Cho clay loam, in an area of Cho association, undulating; 8.6 miles southeast of the Schleicher County Courthouse on Ranch Road 2596 and 50 feet east in an area of rangeland:

A11—0 to 4 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate very fine subangular blocky; hard, firm; many fine roots; 2 percent hard caliche fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; clear wavy boundary.

A12—4 to 9 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, dark brown (10YR 3/3) moist; moderate fine granular structure; hard, firm; many fine roots; 30 percent calcium carbonate concretions from 1/8 inch to 1 inch across; calcareous; moderately alkaline; abrupt wavy boundary.

C1cam—9 to 18 inches; white (10YR 8/2) indurated caliche, very pale brown (10YR 7/3) moist; the upper 1 1/2 inches is cracked and platy, thin layers of brownish soil and roots between the plates; calcareous; moderately alkaline; gradual wavy boundary.

C2—18 to 48 inches; white (10YR 8/2) caliche, very pale brown (10YR 7/3) moist; a few indurated caliche fragments, 1/4 inch to 1 inch across; calcareous; moderately alkaline.

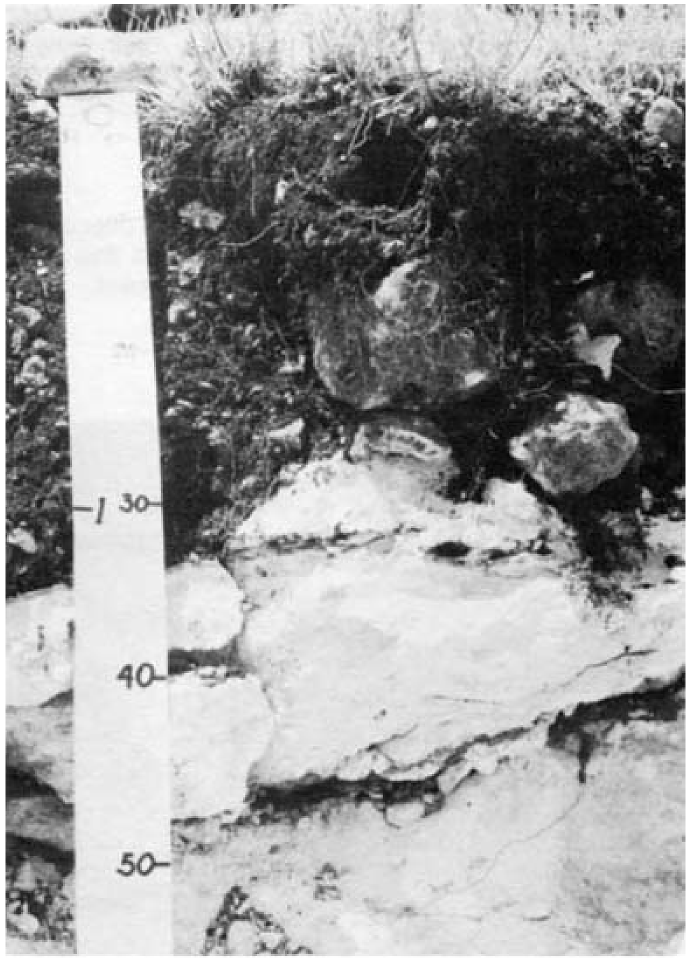


***Figure* 16.—Profile of a Cho soil in an area of the Cho association, undulating.**

The solum ranges from 4 to 12 inches in thickness. It is dark grayish brown, dark brown, grayish brown, or brown. The clay content is 28 to 35 percent. The gravel content is 2 to 30 percent. The content of carbonates ranges from 40 to 60 percent.

The C1cam horizon is white or pinkish white indurated caliche 2 to 10 inches thick. A small part is massive, but most is platy. Thin seams of soil are between the upper plates.

The C horizon is white or yellowish soft caliche or marl.

Dev series

The Dev series consists of deep, very gravelly clay foams that formed in calcareous alluvium. These soils are in flood plains of streams. Flooding is expected each year, but the frequency of flooding may range from several times a year to once in 10 years. Slopes are no more than 3 percent.

Typical pedon of Dev very gravelly clay loam, in an area of Dev-Rioconcho association, frequently flooded; about 24 miles east of the Schleicher County Court-house on U.S. Highway 190, 8.0 miles southeast and 1.0 mile west on county road, and 100 feet south in an area of rangeland:

A11—0 to 12 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure;

hard, firm; few fine roots; 60 percent rounded limestone pebbles and cobbles 1/16 inch to 5 inches across; calcareous; moderately alkaline; gradual wavy boundary.

A12—12 to 30 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure and weak fine subangular blocky; hard, firm; few fine roots; 60 percent rounded limestone pebbles and cobbles 1/16 inch to 5 inches across; calcareous; moderately alkaline; gradual wavy boundary.

C—30 to 80 inches; brown (10YR 5/3) very gravelly clay loam, dark brown (10YR 4/3) moist; moderate fine granular structure and moderate fine subangular blocky; hard, firm; few fine roots; 60 percent rounded limestone pebbles and cobbles 1/16 inch to 5 inches across; calcareous; moderately alkaline.

These soils are more than 48 inches thick over limestone bedrock. The gravel content ranges from 35 to 85 percent. Most coarse fragments are loss than 3 inches across, but in some pedons a few are cobbles and stones. Discontinuous strata of loam or clay loam occur in some pedons. They are commonly near the surface but can occur at any depth. The texture of the soil material is loam or clay loam.

The A1 horizon is 20 to 36 inches thick. It is dark grayish brown or dark brown.

The C horizon is brown or grayish brown.

Ector series

The Ector series consists of very shallow, very gravelly clay learns over hard limestone. Cracks in the limestone are sealed with indurated caliche. The slope range is 1 to 8 percent

Typical pedon of Ector very gravelly clay loam. In an area of Ector association, undulating; from the intersection of Ranch Road 1828 and U.S. Highway 190 about 13 miles west of Eldorado, *2.5* miles west on Texas Highway 29, 4.1 miles south and west on county road. and 100 feet south in an area of rangeland:

A1—0 to 8 inches; dark grayish brown (10YR 4/2) very gravelly clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate very fine to medium subangular blocky: hard, firm; common fine roots; few worm casts; 70 percent fragments of limestone and hard caliche of which 25 percent are cobbles, 20 percent are pebbles larger than 2 centimeters In diameter, and 25 percent are pebbles less than 2 centimeters; calcareous; moderately alkaline; abrupt wavy boundary.

R&Cca—8 to 18 inches; hard fractured limestone coated with calcium carbonate; most cracks in the hard limestone bedrock sealed with indurated caliche coatings 1/4 to 1/3 inch thick; calcareous; moderately alkaline; gradual wavy boundary.

R—18 to 40 inches: fractured limestone bedrock.

The solum is 4 to 12 inches thick over hard limestone. The average thickness is 8 inches. The solum is 50 to 80 percent limestone and indurated caliche fragments. The average content of coarse fragments is 68 percent. Content of pebbles ranges from 10 to 75 percent and content of cobbles from 5 to 60 percent of the soil mass. Stones occur in 10 percent of the pedons. The content of carbonates less than 20 millimeters in diameter ranges from 40 to 65 percent of the soil mass. Secondary carbonates form powdery coatings. concretions, Or indurated layers less than 1 inch thick on fragments or on the underlying limestone. Cracks in the limestone are sealed. The color of the fine material is dark grayish brown, very dark brown, or dark brown. The texture of the fine material ranges from 20 to 35 percent clay.

Kavett series

The Kavett series consists of shallow clays over indurated limestone (fig. 17). Those soils are on the high, broad divides. Slopes are no more than 3 percent.

Figure 17—Profile at Kavett clay.

Typical pedon of Kavett clay, in an area of Kavett-Tarrant association, nearly level; 4.7 miles east of the Schleicher County Courthouse on U.S. Highway 190, 4.2 miles south and east on a county road, and 50 feet south in an area of rangeland:

A11—0 to 5 inches; dark grayish brown (10YR 4/2) clay, very dark brown (10YR 2/2) moist; moderate fine granular structure and moderate medium subangular blocky; very hard, very firm; 5 percent limestone fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; clear wavy boundary.

A12—5 to 14 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate very fine to medium subangular blocky structure; very hard, very firm; 5 percent angular limestone fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—14 to 16 inches; white (10YR 8/1) platy and nodular indurated caliche, smooth on top, knobby below, most have a nucleus of limestone; 5 percent is thin seams of soil between the plates containing mats of roots; calcareous; moderately alkaline; abrupt wavy boundary.

R—16 to 30 inches; white (10YR 8/2) hard limestone.

The solum ranges from 10 to 20 inches in thickness. Limestone pebbles, cobbles, and stones in the soil and on the surface make up 0 to 15 percent of the soil material. The clay content ranges from 40 to 50 percent.

The A horizon is dark grayish brown or brown.

The Ccam horizon ranges from strongly cemented to indurated. All cracks in the underlying limestone are sealed with hard caliche. In some pedons flattened indurated caliche nodules are on top of the continuous layer.

Lipan series

The Lipan series consists of deep clays over limestone. These soils are in nearly level depressions which impound water during rainy seasons. Limestone strata are below 48 inches. Slopes are no more than 1 percent.

Typical pedon of Lipan clay; 3.1 miles west of the Schleicher County Courthouse on U.S. Highway 190 and 50 yards north in cropland:

Ap—0 to 5 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine granular structure and moderate very fine to coarse blocky; extremely hard, very firm, sticky; a few pebbles from 1/8 inch to 3 inches across are at the surface; calcareous; moderately alkaline; abrupt smooth boundary.

A1—5 to 36 inches; gray; (10YR 5/1) clay, dark gray (10YR 4/1) moist; moderate fine to coarse blocky structure; extremely hard, very firm, sticky; filled cracks 1/4 inch wide at 15 inch intervals; distinct wedge-shaped peds and slickensides below 18 inches; few pebbles 1/8 to 1/4 inch across; calcareous; moderately alkaline; diffuse wavy boundary.

AC—36 to 65 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist, moderate fine to coarse blocky structure; extremely hard, very firm, sticky; few limestone pebbles 1/8 to 1/4 inch across; calcareous; moderately alkaline; clear wavy boundary.

Cca—65 to 69 inches; grayish brown (10YR 5/2) clay, grayish brown (10YR 5/2) moist; moderate fine to coarse blocky structure; extremely hard, very firm, slightly sticky; mostly marl with some soil mixed in, one-fourth soft white masses of calcium carbonate; a few concretions of caliche 1/8 inch to 1/4 inch across; calcareous; moderately alkaline; abrupt wavy boundary.

R—69 to 80 inches; yellowish limestone.

The solum is more than 40 inches thick. The clay content ranges from 40 to 60 percent. When the soil is dry, cracks from 2 to 3 inches wide extend downward 30 to 60 inches. In areas that have never been plowed, the gilgai microrelief consists of a few narrow troughs with no corresponding ridges or of rounded pits 20 to 60 feet apart (fig. 18). The pits and troughs are about 2 to 8 inches deep. The structure is weak to strong blocky. Many of the peds are wedge shaped with axis tilted more than 10 degrees from horizontal. Slickensides occur below 18 inches.

Figure 18.—**The surface or Lipan clay has small pits caused by the very high shrink-swell potential of the soil.**

The content of calcium carbonate in the Cca horizon ranges from a few powdery masses to 40 percent by volume. The strongest concentrations typically include concretions 1/8 inch to 1/2 inch across.

Limestone bedrock occurs below 4 feet.

Mereta series

The Mereta series consists of loamy soils that are shallow over indurated caliche. These soils formed in highly calcareous clayey material. Depth to the indurated caliche layer is 14 to 20 inches. These soils are on broad, nearly level divides. Slopes are no more than 3 percent.

Typical pedon of Mereta clay loam, in an area of Valera-Mereta-Kavett association, nearly level; 13.1 miles south of the Schleicher County Courthouse on Ranch Road 2596 and 50 feet east in an area of rangeland:

A11—0 to 10 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate fine subangular blocky; very hard, firm; common fine roots; few worm casts; calcareous; moderately alkaline; clear wavy boundary.

A12—10 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; very hard, firm; common fine roots; few worm casts; few indurated caliche fragments and rounded nodules 114 to 112 inch in diameter in the lower part; calcareous; moderately alkaline; abrupt wavy boundary.

C1cam—16 to 25 inches; white (10YR 8/2) indurated caliche, very pale brown (10YR 8/3) moist. platy but continuous, plates are 1/4 inch to 1 1/2 inches thick; calcareous; moderately alkaline; gradual wavy boundary.

C2ca—25 to 48 inches: white (10YR 8/2) marl with soft caliche, very pale brown (10YR 7/4) moist: a discontinuous limestone layer 4 inches thick is at 40 inches; calcareous; moderately alkaline.

The solum ranges from 14 to 20 inches in thickness. It is calcareous throughout. The clay content is more than 35 percent. Color is dark grayish brown, grayish brown, or brown. In the lower part some pedons have a layer of calcium carbonate concretions that are 118 inch to 1 inch across.

The C1cam horizon of indurated caliche ranges from 2 to 12 inches in thickness. Some is massive, but most is platy. The plates are 1/4 inch to 3 inches thick. In some pedons, tree roots are between the plates.

The C2ca horizon is caliche or marl. The content of secondary carbonates decreases with increasing depth.

Rioconcho series

The Rioconcho series consists of deep, loamy bottom land soils These soils formed in calcareous alluvium Flooding occurs about once in 1 to 50 years, but the lowest areas may be flooded three times a year. Slopes are no more than 3 percent.

Typical pedon of Rioconcho clay loam. Occasionally flooded; about 24 miles east of the Schleicher County Courthouse on U.S. Highway 190, 8.0 miles southeast and 2.0 miles northeast on county road, and 2,000 feet north in an area of rangeland (this point is also 400 feet south of the San Saba River and 200 feet west of the county line):

A11—0 to 20 Inches; dark gray (10YR 4/1) clay loam, very dark gray (10YR 3/1) moist; moderate fine granular structure and moderate fine subangular blocky; very hard, firm; many line roots; few threads of calcium carbonate; few angular limestone fragments on the surface; calcareous; moderately alkaline; gradual wavy boundary.

A12—20 to 40 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine to medium subangular blocky structure; very hard, firm; few fine roots; few worm casts; calcareous; moderately alkaline; diffuse wavy boundary.

C—40 to 60 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; very hard, firm; few small masses of calcium carbonate; calcareous; moderately alkaline; abrupt boundary.

IIC—60 to 80 inches; dominantly rounded limestone gravel; soil material similar to horizon above in spaces around gravel.

These soils are more than 48 inches thick over limestone or very gravelly strata. The content of rounded limestone pebbles ranges from 0 to 10 percent. The clay content is more than 35 percent. The organic matter content is very high. Color of the upper part is dark grayish brown, grayish brown, very dark grayish brown, or dark gray. Below 40 inches is pale brown, brown, grayish brown, or light brown. Below 40 inches in some pedons are strata that are as much as 20 to 40 percent rounded limestone pebbles. Some pedons do not have gravel strata at 60 inches.

Tarrant series

The Tarrant series consists of very shallow, clayey soils over hard limestone. More than 35 percent of the soil material is limestone fragments of stone, cobble, and pebble size. The underlying limestone is fractured. The cracks are open. The slope range is 0 to 30 percent.

Typical pedon of Tarrant cobbly clay, in an area of Tarrant association, undulating; 0.8 mile north of the Schleicher County Courthouse on U.S. Highway 277, 9.3 miles northeast on a county road, 3.9 miles north on another county road, 3.0 miles east on another county road, and 50 feet east in an area of rangeland:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) cobbly clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and moderate very fine subangular blocky; hard, firm; about 50 percent cobbles and pebbles, most of which have an indurated caliche coating on the underside; stones are about 20 feet apart at the surface, cobbles and pebbles cover about 20 percent of the surface; calcareous; moderately alkaline; abrupt wavy boundary.

A12ca—8 to 10 inches; dark grayish brown (10YR 4/2) cobbly clay, dark brown (10YR 3/3) moist; moderate fine granular structure and moderate very fine subangular blocky; hard, firm; 60 percent caliche nodules and caliche coated limestone fragments 1/8 inch to 2 inches across; calcareous; moderately alkaline; abrupt wavy boundary.

R—10 to 30 inches; white (2.5YR 8/2) fractured hard limestone; a one-eighth inch thick indurated caliche coating on the upper side extends into some of the fractures.

The solum thickness over hard limestone ranges from 4 to 18 inches. The solum is 35 to 80 percent limestone fragments ranging in size from fine gravel to stones 4 feet across. The percentage of fragments increases with increasing depth. Two-thirds of the pedons have stones, and nearly all have cobbles and pebbles. The soil mass is less than 20 percent pebbles less than 2 centimeters in diameter. The texture of the fine material is clay or silty clay. The clay content ranges from 40 to 50 percent. Colors are dominantly dark gray or dark grayish brown, but gray, grayish brown, very dark gray, and very dark grayish brown also occur.

Secondary carbonates, mostly in the lower part of the solum, occur as powdery coatings, concretions, or indurated coatings less than 1 inch thick on fragments or on the underlying limestone. The coatings on fragments are thicker on the bottom side than on the top side.

Tobosa series

The Tobosa series consists of deep clays over lime-stone. These soils have wide cracks when dry (fig. 19). They have weakly expressed microrelief. Slopes are nearly level or slightly depressed and are no more than 1 percent.

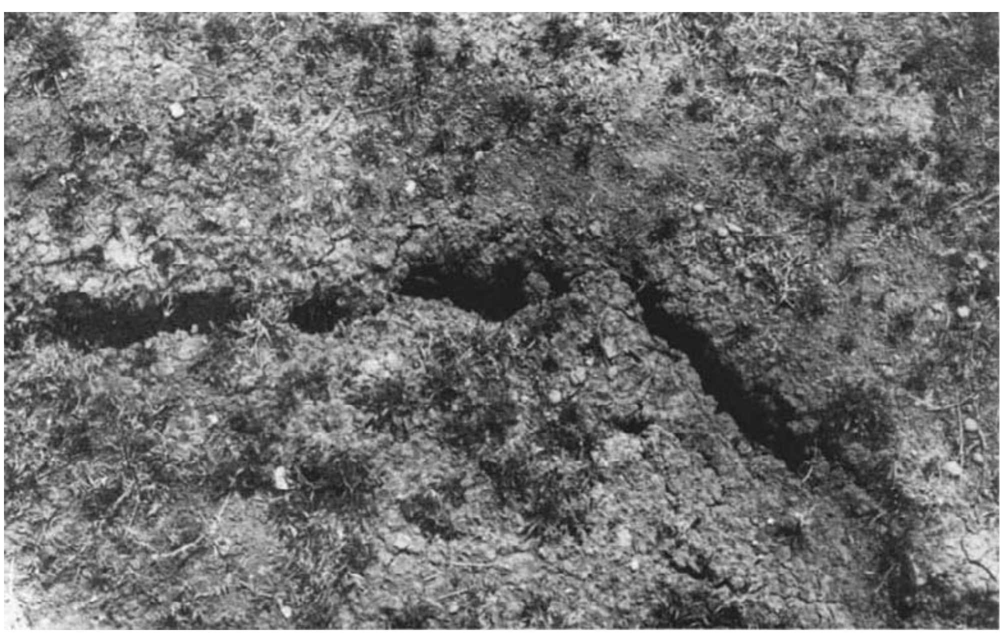


***Figure* 19.—Tobosa clay cracks as it dries and expands with great force when it is moistened.**

Typical pedon of Tobosa clay, 0 to 1 percent slopes; from the intersection of U.S. Highway 190 and Ranch Road 1828 about 13 miles west of Eldorado, 2.6 miles north of Ranch Road 1828 and 100 feet east in an area of rangeland:

A11—0 to 8 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure and strong fine to coarse subangular blocky; extremely hard, very firm, sticky and plastic; common very fine roots; few fine limestone fragments; few worm casts; 1 inch thick surface mulch of fine granules; calcareous; moderately alkaline; clear wavy boundary.

A12—8 to 24 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak fine to coarse blocky; extremely hard, very firm, sticky and plastic; common very fine roots; few fine limestone fragments; darker vertical streaks about 1 /2 inch wide at 1 foot intervals; many wedge-shaped peds with shiny surfaces; slickensides begin at 15 inches; calcareous; moderately alkaline; gradual wavy boundary.

A13—24 to 50 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; strong coarse blocky structure; extremely hard, very firm, sticky and plastic; cracks filled with darker soil are at 1 foot intervals; few fine limestone fragments; several slickensides more than 3 inches across; calcareous; moderately alkaline; diffuse wavy boundary.

ACca—50 to 58 inches; brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate coarse blocky structure; extremely hard, very firm, sticky and plastic; few soft masses of calcium carbonate 2 millimeters across; calcareous; moderately alkaline; abrupt wavy boundary.

R—58 to 80 inches; very pale brown (10YR 7/3) hard limestone.

The solum ranges from 40 to 80 inches in thickness. When the soil is dry, cracks as much as 3 inches wide extend well into the AC horizon. In unplowed areas, these soils have gilgai microrelief, mostly as small depressions 1 to 6 inches deep and 2 to 12 feet across. The clay content ranges from 45 to 60 percent.

The A1 horizon ranges from 23 to 50 inches in thickness. It is dark brown, dark grayish brown, or grayish brown.

The AC horizon ranges from 13 to 30 inches in thickness. It is brown or dark brown.

A zone of calcium carbonate accumulation occurs in nearly all pedons. It ranges from a few soft calcium carbonate masses to a layer 14 inches thick that is about 60 percent soft calcium carbonate. Some pedons have coatings of calcium carbonate on the underlying limestone. The boundary to the limestone is wavy to irregular.

Valera series

The Valera series consists of moderately deep, clayey soils that formed in marl or over limestone. Slopes are no more than 3 percent.

Typical pedon of Valera clay, in an area of Valera-Mereta-Kavett association, nearly level; 0.6 mile northwest of the Schleicher County Courthouse on Ranch Road 915, 6.8 miles west and north on a county road, and 300 feet north in an area of rangeland:

A11—0 to 10 inches; very dark grayish brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; moderate fine granular structure and moderate very fine to fine subangular blocky; very hard, firm; 2 percent caliche concretions and limestone fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; gradual wavy boundary.

A12—10 to 32 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) moist; moderate very fine to fine subangular blocky structure; very hard, firm; 5 percent caliche concretions and limestone fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; gradual wavy boundary.

B2—32 to 40 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, firm; 15 percent caliche concretions and limestone fragments 1/8 inch to 1 inch across; calcareous; moderately alkaline; abrupt wavy boundary.

Ccam—40 to 42 inches; white (10YR 8/2) indurated caliche; nodules of indurated caliche 1/8 inch to 8 inches across in a layer on top of a continuous indurated layer 1/4 to 1/2 inch thick on the underlying limestone, the larger ones flattened and smooth on top and rough below; calcareous; moderately alkaline; abrupt wavy boundary.

R—42 to 50 inches; white hard limestone.

The solum ranges from 20 to 40 inches in thickness. The clay content ranges from 40 to 55 percent.

The A horizon ranges from 7 to 35 inches in thickness. It is dark grayish brown, very dark grayish brown, or grayish brown. Dry weather cracks are about 1/3 inch to 1 inch wide.

The B horizon ranges from 8 to 18 inches in thickness. It is brown or light brown. Dry weather cracks are 1 inch wide.

The Ccam horizon ranges from 1 inch to 4 inches in thickness. If thin, it is an indurated caliche coating on the underlying limestone. If thicker, it includes flat indurated caliche nodules and plates on top of the continuous layer.

Formation of the soils

In this section the factors of soil formation are discussed and related to the soils in the survey area. In addition, the processes of soil formation are described.

Factors of soil formation

The characteristics of a soil at any given point depend on (1) the physical and mineral composition of the parent material, (2) the climate under which the soil material has accumulated and has existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, or lay of the land, and (5) the length of time the soil-forming processes have acted on the soil material.

All five of these factors are important in the formation of every soil; some have had more influence than others in different locations. These factors are defined in the following paragraphs.

Parent material

Parent material is the unconsolidated material from which a soil forms. The kind of parent material determines the rate of profile formation, the kind of profiles that form, and the chemical and mineral composition of the soil. It also influences the relief.

The soils of Schleicher County formed in material weathered from rock of Lower Cretaceous age or from alluvium derived from those formations (3). The rock is extremely high in content of calcium carbonate. All soils in the county, therefore, are calcareous. The rock varies in hardness from very hard limestone to marl. Marl is calcium carbonate mixed with varying amounts of clay.

The hardness of the limestone influences soil depth. Softer limestone and marl weather to soil more readily than hard limestone, so the soils formed from them are deeper. Tobosa and Valera soils formed in this softer material. Because the harder and more resistant limestone weathers to soil more slowly, the soils formed are shallower. Tarrant and Ector soils formed in harder material.

The hardness of the limestone also influences soil slope. A thick hard limestone layer is so resistant to weathering that it forms a protective caprock on many hills. The caprock protects the material under it, but the adjacent slopes wear down and become steeper, as in the Tarrant association, hilly, for example. Limestone of intermediate hardness tends to form a landscape of lower, rounded hills. A good example is the Ector association, undulating.

Old alluvium is the parent material of Angelo soils, and recent alluvium is the parent material of Dev and Rioconcho soils. Because deep, loose alluvial deposits allow soil development to a great depth, those soils are the deepest in the county.

Climate

Climate influences the formation of soils directly through rainfall, evaporation, temperature, and wind and indirectly through its influence on relief and on the amount of plant and animal life. Change is fastest when the soil is moist and warm. Most of the differences among soils in this county cannot be attributed to differences in climate alone because the climate is uniform. Because the annual rainfall is low and evaporation high, there is an accumulation of minerals in the soils and little leaching. All the soils are calcareous throughout and are high in content of plant nutrients. Water carries calcium carbonate downward in the soil. For this reason, most of the soils have a distinct zone of calcium carbonate accumulation at the normal wetting depth.

In deeper soils such as Angelo and Tobosa, the zone of accumulation is diffused. In shallower soils like Mereta, Kavett, and Cho, it is concentrated and cemented.

Plant and animal life

Plants, micro-organisms, earthworms, insects, and larger animals that live in or on the soil all contribute to soil formation.

Grasses contribute large amounts of organic matter to the soil, and their fiberous root systems help in keeping the soil porous and granular. Decayed organic matter darkens soils. Soils that have a thick dark surface layer—Angelo, Cho, Dev, Ector, Kavett, Mereta, Rioconcho, Tarrant, and Valera soils—make up about 88 percent of the county.

In some places tree roots have loosened the rock beneath the soil, making it possible for other plant roots to penetrate to greater depths. This is especially evident in the Tarrant soil.

Micro-organisms such as fungi and bacteria help to decay organic matter and to break down parent material, all of which improves fertility. Burrowing animals such as ants, earthworms, and badgers improve soil structure and thereby aid the movement of water and the growth of plant roots.

Man too affects soil formation. Some of his activities drastically change soils. Plowing mixes the upper layers, hastens the decay of organic matter, reduces the water intake rate, and bares the soil to blowing and water erosion. During construction, soils are excavated, buried, or mixed with worthless material. Some are leveled and made deeper.

Relief

Relief is influenced by geology, climate, and time. Relief influences soil formation through its effect on drainage, runoff, and erosion. The hilly or undulating Tarrant, Ector, and Cho soils lose much rainfall through runoff. All are very shallow because little moisture is available for living organisms and because soil is lost through water erosion nearly as fast as it forms. The nearly level Lipan, Tobosa, and Angelo soils are deep because they absorb a lot of moisture. These soils receive runoff from higher soils. Mereta and Kavett soils are intermediate in depth and in the amount of water absorbed.

Time

A long time is required for the soil-forming factors of climate, plant and animal life, and relief to act on the parent material.

The first easily recognized step in soil formation is a darkening of the surface layer caused by the decay of organic matter. At first there is only a thin layer; with time, it darkens and thickens.

A second step is the development of a subsoil with structure and some chemical changes, such as the leaching of bases. This is the stage of development of the Dev and Rioconcho soils. Because the parent material of these soils is recent, time has been inadequate to reach the third step.

A third step is the removal of calcium carbonate from the solum and its redepostion below as a zone of calcium carbonate accumulation. At early stages only a small amount of calcium carbonate is visible at the normal wetting depth. At later stages a distinct layer containing some calcium carbonate concretions is visible. Angelo soils are at this stage. In the final stage an indurated caliche layer forms. Cho, Mereta, and Kavett soils have reached this stage.

Another stage of development occurs after all the free carbonates have been leached from the solum. Carbonates immobilize clay particles. After the carbonates have been removed, clay is moved downward with the soil water. None of the soils in Schleicher County have reached this stage of development.

Tobosa and Lipan soils do not fit the preceding development pattern. When dry, these two soils have wide cracks into which surface soil material falls. When wet, the soil expands, the cracks close, and some soil material is forced upward. With new material at the surface, soil formation must start again.

References

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.
(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.
(3) Bureau of Economic Geology. The University of Texas at Austin. 1974. Geologic Atlas Sheet of Texas, San Angelo Sheet.
(4) Texas Conservation Needs Committee. 1970. Conservation needs inventory. U.S. Dep. Agric., Soil Conserv. Serv., 297 pp., illus.
(5) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]
(6) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Medium	6 to 9
High	9 to 12
Very high	More than 12

Base saturation. The degree to which material having cation exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.
Soft.—When dry, breaks into powder or individual grains under very slight pressure.
Cemented.-Hard; little affected by moistening.

Depth to rock. Bedrock is too near the surface for the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:
Excessively drained—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
Well drained—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.
Moderately well drained—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.
Poorly drained—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gilgai. Commonly a succession of microbasins and microknolls in nearly level areas or of microvalleys and microridges parallel with the slope. Typically, the microrelief of Vertisols—clayey soils having a high coefficient of expansion and contraction with changes in moisture content.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual.* The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Karst (topography). The relief of an area underlain by limestone that dissolves in differing degrees, thus forming numerous depressions or small basins.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Leaching. The removal of soluble material from soil or other material by percolating water.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three-dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Peres slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the underlying material. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Sinkhole. A depression in the landscape where limestone has been dissolved.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slicken sides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake (in tables). The slow movement of water into the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* {angular or subangular), and *granular. Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress road-banks, lawns, and land affected by mining.

Trace elements. Chemical elements, for example, zinc, cobalt, manganese, copper, and iron, are in soils in extremely small amounts. They are essential to plant growth.

Tables

The tables in this soil survey contain information that affects land use planning in this survey area. More current data tables may be available from the Web Soil Survey.

TABLE 1.--POTENTIAL AND LIMITATIONS OF MAP UNITS ON THE GENERAL SOIL MAP

Soil unit	Extent of area	Cultivated and specialty crops	Range	Urban uses	Recreation areas
	Pct				
1. Tarrant-Ector	60	Low: depth to rock, slope, large stones, erodes easily.	Low: depth to rock, droughty, slope.	Low: depth to rock, slope, large stones, corrosivity.	Low: too clayey, slope, large stones, depth to rock.
2. Tobosa-Valera-Mereta	31	Medium: depth to rock, cemented pan, too clayey, large stones.	Medium: depth to rock.	Low: shrink-swell, depth to rock, too clayey, percs slowly, corrosivity.	Low: too clayey, percs slowly.
3. Angelo	9	High	High	Low: shrink-swell, percs slowly, corrosivity.	Low: too clayey, percs slowly.

TABLE 2.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
1	Angelo silty clay loam, 0 to 1 percent slopes	66,840	7.8
2	Cho association, undulating	77,880	9.1
3	Dev-Rioconcho association, frequently flooded	9,550	1.1
4	Ector association, undulating	53,050	6.2
5	Kavett-Tarrant association, nearly level	56,790	6.7
6	Lipan clay	7,090	0.8
7	Rioconcho clay loam, occasionally flooded	970	0.1
8	Tarrant association, undulating	313,950	36.9
9	Tarrant association, hilly	16,960	2.0
10	Tobosa clay, 0 to 1 percent slopes	99,240	11.7
11	Valera-Mereta-Kavett association, nearly level	149,520	17.6
	Total	851,840	100.0

TABLE 3.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields in columns N are for nonirrigated soils; those in columns I are for irrigated soils. All yields were estimated for a high level of management. Absence of a yield figure indicates the crop is seldom grown or is not suited. Only arable soils are listed.]

Soil name and map symbol	Cotton		Grain sorghum		Wheat		Pasture	
	N	I	N	I	N	I	N	I
	Lb	Lb	Bu	Bu	Bu	Bu	AUM*	AUM*
1 Angelo	200	---	30	---	20	---	---	---
2** Cho	---	---	---	---	10	---	1.5	---
3**: Rioconcho soil	---	---	---	---	---	---	3.5	---
5**: Kavett soil	---	---	---	---	15	---	2.0	---
7 Rioconcho	250	---	35	---	---	---	3.5	---
10 Tobosa	250	---	30	---	20	---	2.5	---
11**: Valera	200	---	35	---	20	---	4.0	---
Mereta	200	---	25	---	20	---	2.0	---
Kavett	---	---	---	---	15	---	2.0	---

* Animal-unit-month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.
** See map unit description for the composition and behavior characteristics of the map unit.

TABLE 4.--CAPABILITY CLASSES AND SUBCLASSES

[All soils are assigned to nonirrigated capability subclasses (N). Only potentially irrigable soils are assigned to irrigated subclasses (I). Miscellaneous areas are excluded. Dashes mean no acreage]

Class		Total acreage	Major management concerns (Subclass)			
			Erosion (e)	Wetness (w)	Soil problem (s)	Climate (c)
			Acres	Acres	Acres	Acres
I	(N)	---	---	---	---	---
	(I)	67,810	---	---	---	---
II	(N)	65,260	---	---	64,290	970
	(I)	106,330	---	---	106,330	---
III	(N)	280,840	114,760	---	99,240	66,840
	(I)	---	---	---	---	---
IV	(N)	7,090	---	7,090	---	---
	(I)	---	---	---	---	---
V	(N)	3,340	---	3,340	---	---
VI	(N)	84,090	---	6,210	77,880	---
VII	(N)	411,220	---	---	411,220	---
VIII	(N)	---	---	---	---	---

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Soils not listed do not support rangeland vegetation suited to grazing]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1----- Angelo	Clay Loam-----	Favorable	4,000	Sideoats grama-----	30
		Normal	3,500	Cane bluestem-----	15
		Unfavorable	2,500	Curlymesquite-----	10
				Buffalograss-----	10
				Vine-mesquite-----	10
				Tall dropseed-----	5
				Texas needlegrass-----	5
				Tobosa-----	5
				Slim tridens-----	5
2*----- Cho	Very Shallow-----	Favorable	2,500	Sideoats grama-----	30
		Normal	2,000	Slim tridens-----	15
		Unfavorable	1,000	Little bluestem-----	10
				Buffalograss-----	10
				Curlymesquite-----	10
				Wright threeawn-----	10
				Hairy tridens-----	10
3*:					
Dev-----	Draw-----	Favorable	4,000	Sideoats grama-----	25
		Normal	3,000	Cane bluestem-----	20
		Unfavorable	1,000	Vine-mesquite-----	10
				Buffalograss-----	8
				Curlymesquite-----	7
				Plains bristlegrass-----	5
Rioconcho-----	Loamy Bottom Land-----	Favorable	4,000	Sideoats grama-----	15
		Normal	3,500	Indiangrass-----	10
		Unfavorable	2,500	Silver bluestem-----	10
				Canada wildrye-----	10
				Vine-mesquite-----	10
				Plains lovegrass-----	5
				Texas needlegrass-----	5
				Plains bristlegrass-----	5
				Tall dropseed-----	5
				Buffalograss-----	5
				Curlymesquite-----	5
				Switchgrass-----	5
4*----- Ector	Limestone Hill-----	Favorable	900	Black grama-----	15
		Normal	700	Sideoats grama-----	15
		Unfavorable	400	Slim tridens-----	5
				Cane bluestem-----	5
				Little bluestem-----	5
				Fall witchgrass-----	5
				Green sprangletop-----	5
				Plains bristlegrass-----	5
5*:					
Kavett-----	Shallow-----	Favorable	3,000	Sideoats grama-----	25
		Normal	2,500	Buffalograss-----	13
		Unfavorable	2,000	Curlymesquite-----	10
				Slim tridens-----	10
				Wright threeawn-----	5
				Reverchon panicum-----	5
				Plains bristlegrass-----	5
				Cane bluestem-----	5
				Arizona cottontop-----	5
				Green sprangletop-----	5
				Texas needlegrass-----	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
5*:					
Tarrant	Low Stony Hills	Favorable	2,500	Little bluestem	15
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,200	Curlymesquite	10
				Buffalograss	5
				Green sprangletop	5
				Texas needlegrass	5
				Texas cupgrass	5
				Tall dropseed	5
				Silver bluestem	5
				Live oak	5
6 Lipan	Lakebed	Favorable	4,000	Buffalograss	25
		Normal	2,500	Vine-mesquite	25
		Unfavorable	500	White tridens	10
				Knotgrass	10
7 Rioconcho	Loamy Bottom Land	Favorable	4,000	Sideoats grama	15
		Normal	3,500	Indiangrass	10
		Unfavorable	2,500	Silver bluestem	10
				Canada wildrye	10
				Vine-mesquite	10
				Plains lovegrass	5
				Texas needlegrass	5
				Plains bristlegrass	5
				Tall dropseed	5
				Buffalograss	5
				Curlymesquite	5
				Switchgrass	5
8* Tarrant	Low Stony Hills	Favorable	2,500	Little bluestem	15
		Normal	1,800	Sideoats grama	15
		Unfavorable	1,200	Curlymesquite	10
				Buffalograss	5
				Green sprangletop	5
9* Tarrant	Steep Rocky	Favorable	1,800	Sideoats grama	20
		Normal	1,400	Silver bluestem	15
		Unfavorable	800	Little bluestem	10
				Green sprangletop	10
				Indiangrass	5
				Fall witchgrass	5
				Live oak	5
10 Tobosa	Clay Flat	Favorable	3,000	Tobosa	40
		Normal	2,500	Buffalograss	15
		Unfavorable	1,000	Sideoats grama	10
				Curlymesquite	5
				Cane bluestem	5
				Vine-mesquite	5
				Texas needlegrass	5
				Wright threeawn	5
11*:					
Valera	Clay Loam	Favorable	4,000	Sideoats grama	30
		Normal	3,500	Cane bluestem	15
		Unfavorable	2,500	Curlymesquite	10
				Buffalograss	10
				Vine-mesquite	10
				Tall dropseed	5
				Texas needlegrass	5
				Tobosa	5
				Slim tridens	5

See footnote at end of table.

TABLE 5.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Compo-sition
		Kind of year	Dry weight		
			Lb/acre		Pct
11*:					
Mereta	Shallow	Favorable	3,000	Sideoats grama	25
		Normal	2,500	Buffalograss	13
		Unfavorable	1,800	Curlymesquite	10
				Slim tridens	10
				Wright threeawn	5
				Reverchon panicum	5
				Plains bristlegrass	5
				Cane bluestem	5
				Arizona cottontop	5
				Green sprangletop	5
				Texas needlegrass	5
Kavett	Shallow	Favorable	3,000	Sideoats grama	25
		Normal	2,500	Buffalograss	13
		Unfavorable	2,000	Curlymesquite	10
				Slim tridens	10
				Wright threeawn	5
				Reverchon panicum	5
				Plains britlegrass	5
				Cane bluestem	5
				Arizona cottontop	5
				Green sprangletop	5
				Texas needlegrass	5

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 6.--RECREATIONAL DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1 Angelo	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Moderate: too clayey, percs slowly.	Moderate: too clayey.
2* Cho	Slight	Slight	Moderate: slope, small stones.	Slight.
3*:				
Dev	Severe: floods, small stones.	Severe: small stones.	Severe: floods, small stones.	Severe: small stones.
Rioconcho	Moderate: percs slowly, floods, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey, floods.	Moderate: too clayey.
4* Ector	Moderate: small stones, slope.	Moderate: small stones, slope.	Severe: slope, depth to rock, small stones.	Moderate: slope, small stones.
5*:				
Kavett	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Tarrant	Severe: large stones, too clayey.	Severe: large stones, too clayey.	Severe: depth to rock, large stones.	Severe: large stones, too clayey.
6 Lipan	Severe: floods, percs slowly, too clayey.	Severe: floods, too clayey.	Severe: floods, percs slowly, too clayey.	Severe: floods, too clayey.
7 Rioconcho	Moderate: percs slowly, floods, too clayey.	Moderate: too clayey.	Moderate: percs slowly, too clayey, floods.	Moderate: too clayey.
8* Tarrant	Severe: large stones, depth to rock.	Severe: large stones.	Severe: depth to rock, large stones, too clayey.	Severe: large stones.
9* Tarrant	Severe: large stones, slope.	Severe: large stones, too clayey.	Severe: depth to rock, slope.	Severe: large stones, too clayey.
10 Tobosa	Severe: percs slowly, too clayey.	Severe: too clayey.	Severe: percs slowly, too clayey.	Severe: too clayey.
11*:				
Valera	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Mereta	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: cemented pan.	Moderate: too clayey.
Kavett	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 7.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates the soil was not rated]

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
1: Angelo	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
2*: Cho	Fair	Poor	Poor	Poor	Poor	Very poor	Poor	Very poor	Poor.
3*:									
Dev	Poor	Poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
Rioconcho	Poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
4*: Ector	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
5*:									
Kavett	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Tarrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
6: Lipan	Fair	Fair	Fair	Very poor	Poor	Fair	Fair	Poor	Poor.
7: Rioconcho	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
8*: Tarrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
9*: Tarrant	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
10: Tobosa	Fair	Fair	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
11*:									
Valera	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Mereta	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Kavett	Fair	Fair	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 8.--BUILDING SITE DEVELOPMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry means soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1 Angelo	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
2* Cho	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.	Moderate: cemented pan.
3*:					
Dev	Severe: floods, small stones.	Severe: floods.	Severe: floods.	Severe: floods.	Severe: floods.
Rioconcho	Severe: floods.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, low strength.
4* Ector	Severe: depth to rock, small stones.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
5*:					
Kavett	Severe: depth to rock, too clayey.	Severe: depth to rock, shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.
Tarrant	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.
6 Lipan	Severe: floods, too clayey, cutbanks cave.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, low strength.
7 Rioconcho	Severe: floods.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell.	Severe: floods, shrink-swell, low strength.
8* Tarrant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
9* Tarrant	Severe: depth to rock.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.	Severe: depth to rock, large stones.
10 Tobosa	Severe: too clayey, cutbanks cave.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
11*:					
Valera	Severe: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, depth to rock.	Severe: shrink-swell, low strength.
Mereta	Moderate: cemented pan.	Moderate: cemented pan, shrink-swell.	Moderate: cemented pan, shrink-swell.	Moderate: cemented pan, shrink-swell.	Moderate: cemented pan, shrink-swell.
11*:					
Kavett	Severe: depth to rock, too clayey.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.	Severe: depth to rock, low strength, shrink-swell.

See footnote at end of table.

TABLE 8.--BUILDING SITE DEVELOPMENT--Continued

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 9.--SANITARY FACILITIES

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms used to rate soils. Absence of an entry means soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1 Angelo	Severe: percs slowly.	Moderate: seepage.	Severe: too clayey.	Slight	Fair: too clayey.
2* Cho	Severe: cemented pan.	Severe: cemented pan.	Moderate: cemented pan.	Slight	Poor: thin layer.
3*:					
Dev	Severe: floods.	Severe: floods, seepage, small stones.	Severe: floods, seepage.	Severe: floods, seepage.	Poor: small stones.
Rioconcho	Severe: percs slowly, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
4* Ector	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, small stones.
5*:					
Kavett	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: thin layer, too clayey.
Tarrant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: thin layer, large stones, too clayey.
6 Lipan	Severe: floods, percs slowly.	Slight	Severe: floods, too clayey.	Severe: floods.	Poor: too clayey.
7 Rioconcho	Severe: percs slowly, floods.	Severe: floods.	Severe: floods.	Severe: floods.	Fair: too clayey.
8* Tarrant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: area reclaim, too clayey.
9* Tarrant	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: slope.	Poor: thin layer, large stones, too clayey.
10 Tobosa	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
11*:					
Valera	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Slight	Poor: too clayey.
Mereta	Severe: cemented pan, percs slowly.	Severe: cemented pan.	Moderate: cemented pan.	Slight	Poor: thin layer.
Kavett	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Slight	Poor: thin layer, too clayey.

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 10.--CONSTRUCTION MATERIALS

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," and "unsuited." Absence of an entry means soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1 Angelo	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
2* Cho	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, excess lime.
3*:				
Dev	Good	Unsuited: excess fines.	Poor: excess fines.	Poor: small stones.
Rioconcho	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
4* Ector	Poor: thin layer.	Unsuited: thin layer, excess fines.	Unsuited: thin layer, excess fines.	Poor: thin layer, small stones.
5*:				
Kavett	Poor: thin layer, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Tarrant	Poor: thin layer, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
6 Lipan	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
7 Rioconcho	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
8* Tarrant	Poor: thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim, too clayey, large stones.
9* Tarrant	Poor: thin layer, large stones.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: thin layer, large stones.
10 Tobosa	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
11*:				
Valera	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
Mereta	Moderate: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: area reclaim.
Kavett	Poor: thin layer, shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 11.--WATER MANAGEMENT

[Some of the terms used in this table to describe restrictive soil features are defined in the Glossary. Absence of an entry means soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
1 Angelo	Seepage	Compressible	Percs slowly	Slow intake	Favorable	Favorable.
2* Cho	Cemented pan, seepage.	Thin layer	Not needed	Rooting depth, excess lime.	Cemented pan	Not needed.
3*:						
Dev	Seepage	Seepage	Floods	Floods, seepage, droughty.	Piping, floods.	Droughty.
Rioconcho	Seepage	Compressible, piping.	Floods, percs slowly.	Floods, slow intake.	Percs slowly	Percs slowly.
4* Ector	Depth to rock	Thin layer	Not needed	Rooting depth	Depth to rock	Rooting depth.
5*:						
Kavett	Depth to rock, seepage.	Thin layer	Not needed	Droughty, rooting depth.	Rooting depth	Rooting depth.
Tarrant	Depth to rock	Thin layer, large stones.	Depth to rock	Rooting depth	Depth to rock, large stones.	Rooting depth, large stones.
6 Lipan	Favorable	Compressible, unstable fill.	Floods, percs slowly.	Floods, slow intake.	Percs slowly	Percs slowly.
7 Rioconcho	Seepage	Compressible, piping.	Floods, percs slowly.	Floods, slow intake.	Percs slowly	Percs slowly.
8* Tarrant	Depth to rock	Thin layer, large stones.	Not needed	Rooting depth, large stones, slow intake.	Large stones, depth to rock.	Rooting depth, large stones.
9* Tarrant	Depth to rock	Thin layer, large stones.	Depth to rock	Rooting depth	Depth to rock, large stones.	Rooting depth, large stones.
10 Tobosa	Favorable	Compressible, unstable fill.	Percs slowly, cutbanks cave.	Slow intake	Percs slowly	Percs slowly.
11*:						
Valera	Depth to rock	Compressible, depth to rock.	Not needed	Rooting depth, slow intake.	Depth to rock	Depth to rock.
Mereta	Cemented pan	Thin layer	Cemented pan	Rooting depth	Cemented pan, rooting depth.	Rooting depth, droughty.
Kavett	Depth to rock, seepage.	Thin layer	Not needed	Droughty, rooting depth.	Rooting depth	Rooting depth.

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol < means less than; > means greater than. Absence of an entry means data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
1------------------ Angelo	0-14	Silty clay loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	60-90	37-50	16-27
	14-34	Clay, clay loam, silty clay loam.	CL, CH	A-6, A-7-6	0	90-100	90-100	85-100	70-92	39-60	18-35
	34-80	Clay loam, silty clay loam, clay.	CL, CH	A-6, A-7-6	0	60-100	60-100	60-100	50-90	35-55	15-30
2*----------------- Cho	0-9	Clay loam-------	CL	A-4, A-6	0-5	60-95	55-95	55-80	51-70	25-40	8-20
	9-18	Cemented--------	---	---	---	---	---	---	---	---	---
	18-48	Variable--------	---	---	---	---	---	---	---	---	---
3*: Dev----------------	0-80	Very gravelly clay loam.	GC, GP-GC	A-2-4, A-2-6	0-10	10-53	5-50	5-45	5-35	28-40	9-20
Rioconcho---------	0-80	Clay loam-------	CL, CH	A-6, A-7-6	0-10	85-100	83-100	75-100	70-97	39-62	20-38
4*----------------- Ector	0-8	Very gravelly clay loam.	GC, GM-GC	A-2, A-4, A-6	10-35	30-60	25-55	20-50	15-45	25-35	7-15
	8-40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
5*: Kavett------------	0-14	Clay------------	CH	A-7-6	0-2	90-100	80-100	75-100	70-95	51-66	25-40
	14-30	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
Tarrant-----------	0-9	Cobbly clay-----	CH, GC	A-7-6	33-77	55-100	51-100	51-95	45-95	55-76	31-49
	9-30	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
6------------------ Lipan	0-65	Clay------------	CH	A-7-6	0-15	85-100	80-100	80-100	80-95	55-75	32-49
	65-69	Clay, silty clay	CH	A-7-6	0-15	85-100	80-100	80-100	70-95	46-66	25-40
	69-80	Indurated, unweathered bedrock.									
7------------------ Rioconcho	0-80	Clay loam-------	CL, CH	A-6, A-7-6	0-10	85-100	83-100	75-100	70-97	39-62	20-38
8*----------------- Tarrant	0-10	Cobbly clay-----	CH, GC	A-7-6	33-77	55-100	51-100	51-95	45-95	55-76	31-49
	10-30	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
9*----------------- Tarrant	0-13	Cobbly clay-----	CH, GC	A-7-6	33-77	55-100	51-100	51-95	45-95	55-76	31-49
	13-27	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---
10----------------- Tobosa	0-50	Clay------------	CH	A-7-6	0-5	80-100	75-100	75-100	75-98	51-72	30-45
	50-58	Clay, silty clay	CH, CL	A-7-6	0-5	80-100	75-100	75-100	70-95	45-65	25-40
	58-80	Indurated, unweathered bedrock.									
11*: Valera------------	0-40	Clay------------	CL, CH	A-7-6	0-2	85-100	75-100	75-95	75-90	48-62	24-41
	40-42	Cemented--------	---	---	---	---	---	---	---	---	---
	42-50	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 12.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
11*: Mereta------------	0-16	Clay loam-------	CL, CH	A-6, A-7-6	0-5	90-100	83-100	80-97	60-85	39-52	19-30
	16-25	Variable, cemented.	---	---	---	---	---	---	---	---	---
	25-48	Variable, marl	---	---	---	---	---	---	---	---	---
Kavett------------	0-14	Clay------------	CH	A-7-6	0-2	90-100	80-100	75-100	70-95	51-66	25-40
	14-18	Indurated, unweathered bedrock.	---	---	---	---	---	---	---	---	---

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 13.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

[The symbol < means less than; > means greater than. The erosion tolerance factor (T) is for the entire profile. Wind erodibility group is for the surface layer. Absence of an entry means data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH				
1----------------- Angelo	0-14	0.6-2.0	0.14-0.20	7.9-8.4	Moderate------	0.32	4	7
	14-34	0.2-0.6	0.14-0.20	7.9-8.4	High----------	0.32		
	34-80	0.6-2.0	0.14-0.20	7.9-8.4	Moderate------	0.32		
2*---------------- Cho	0-9	0.6-2.0	0.10-0.15	7.9-8.4	Low-----------	0.28	1	6
	9-18	---	---	---	--------------	---		
	18-48	---	---	---	--------------	---		
3*:								
Dev---------------	0-80	2.0-6.0	0.03-0.10	7.9-8.4	Very low------	0.10	5	8
Rioconcho---------	0-80	0.06-0.2	0.15-0.20	7.4-8.4	High----------	0.32	5	6
4*---------------- Ector	0-8	0.6-2.0	0.05-0.10	7.9-8.4	Very low------	0.10	1	8
	8-40	---	---	---	--------------	---		
5*:								
Kavett------------	0-14	0.2-0.6	0.15-0.20	7.9-8.4	High----------	0.32	1	4
	14-30	---	---	---	--------------	---		
Tarrant-----------	0-9	0.2-0.6	0.10-0.17	7.9-8.4	Low-----------	0.20	1	8
	9-30	---	---	---	--------------	---		
6----------------- Lipan	0-65	<0.06	0.13-0.18	7.4-8.4	Very high-----	0.32	5	4
	65-69	<0.06	0.13-0.18	7.9-8.4	Very high-----	0.32		
	69-80	---	---	---	--------------	---		
7----------------- Rioconcho	0-80	0.06-0.2	0.15-0.20	7.4-8.4	High----------	0.32	5	6
8*---------------- Tarrant	0-10	0.2-0.6	0.10-0.17	7.9-8.4	Low-----------	0.20	1	8
	10-30	---	---	---	--------------	---		
9*---------------- Tarrant	0-13	0.2-0.6	0.10-0.17	7.9-8.4	Low-----------	0.20	1	8
	13-27	---	---	---	--------------	---		
10---------------- Tobosa	0-50	<0.06	0.12-0.18	7.4-8.4	Very high-----	0.32	5	4
	50-58	<0.06	0.10-0.18	7.9-8.4	Very high-----	0.32		
	58-80	---	---	---	--------------	---		
11*:								
Valera------------	0-40	0.2-0.6	0.15-0.20	7.9-8.4	High----------	0.32	2	4
	40-42	---	---	---	--------------	---		
	42-50	---	---	---	--------------	---		
Mereta------------	0-16	0.2-0.6	0.15-0.20	7.9-8.4	Moderate------	0.32	1	6
	16-25	---	---	---	--------------	0.32		
	25-48	---	---	---	--------------	---		
Kavett------------	0-14	0.2-0.6	0.15-0.20	7.9-8.4	High----------	0.32	1	4
	14-18	---	---	---	--------------	---		

* See map unit description for the composition and behavior characteristics of the map unit.

TABLE 14.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See text for descriptions of symbols and terms. The symbol < means less than; > means greater than]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Depth	Hardness	Uncoated steel	Concrete
					Ft			In		In			
1----------------- Angelo	C	None---------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
2*----------------- Cho	C	None---------	---	---	>6.0	---	---	>60	---	8-20	Rippable	High-----	Low.
3*:													
Dev---------------	A	Frequent----	Brief-----	Apr-Jun	>6.0	---	---	>60	---	---	---	Moderate	Low.
Rioconcho---------	C	Frequent----	Very brief to brief.	Apr-Jun	>6.0	---	---	>60	---	---	---	High-----	Low.
4*----------------- Ector	D	None---------	---	---	>6.0	---	---	4-20	Hard	---	---	High-----	Low.
5*:													
Kavett------------	D	None---------	---	---	>6.0	---	---	11-26	Hard	10-20	Hard	High-----	Low.
Tarrant-----------	D	None---------	---	---	>6.0	---	---	6-20	Hard	---	---	High-----	Low.
6----------------- Lipan	D	Common------	Long to very long.	Apr-Jun	>6.0	---	---	>60	---	---	---	High-----	Low.
7----------------- Rioconcho	C	Occasional--	Very brief to brief.	Apr-Jun	>6.0	---	---	>60	---	---	---	High-----	Low.
8*, 9*------------ Tarrant	D	None---------	---	---	>6.0	---	---	6-20	Hard	---	---	High-----	Low.
10----------------- Tobosa	D	None---------	---	---	>6.0	---	---	>60	---	---	---	High-----	Low.
11*:													
Valera------------	C	None---------	---	---	>6.0	---	---	21-52	Hard	20-40	Hard	High-----	Low.
Mereta------------	C	None---------	---	---	>6.0	---	---	>60	---	14-20	Rippable	High-----	Low.
Kavett------------	D	None---------	---	---	>6.0	---	---	11-26	Hard	10-20	Hard	High-----	Low.

* See map unit description for the composition and behavior of the map unit.

TABLE 15.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Angelo	Fine, mixed, thermic Torrertic Calciustolls
Cho	Loamy, carbonatic, thermic, shallow Petrocalcic Calciustolls
Dev	Loamy-skeletal, carbonatic, thermic Cumulic Haplustolls
Ector	Loamy-skeletal, carbonatic, thermic Lithic Calciustolls
Kavett	Clayey, montmorillonitic, thermic, shallow Petrocalcic Calciustolls
Lipan	Fine, montmorillonitic, thermic Entic Pellusterts
Mereta	Clayey, mixed, thermic, shallow Petrocalcic Calciustolls
Rioconcho	Fine, mixed, thermic Vertic Haplustolls
Tarrant	Clayey-skeletal, montmorillonitic, thermic Lithic Calciustolls
Tobosa	Fine, montmorillonitic, thermic Typic Chromusterts
Valera	Fine, montmorillonitic, thermic Petrocalcic Calciustolls

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